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PROCEEDINGS

BEEF IMPROVEMENT FEDERATION

RESEARCH SYMPOSIUM & ANNUAL MEETING

April 29-30, 1980
Stouffer's Denver Inn
Denver, Colorado

PROCEEDINGS OF BEEF IMPROVEMENT FEDERATION

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BEEF IMPROVEMENT FEDERATION

ANNUAL CONVENTION

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Tuesday, April 29

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9:00 - 9:30 a.m.	Convention Convenes
9:30 - 11:45 a.m.	TRAIT COMMITTEE MEETINGS
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4:30 - 5:30 p.m.	BUSINESS MEETING - Mark Keffeler, President
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Wednesday, April 30

7:30 - 8:30 a.m.	REGISTRATION
8:30 - 10:25 a.m.	CONCEPTS FOR THE 80's - AN IN DEPTH LOOK AT SIRE EVALUATION - Richard Spader, Chairman
	WHERE HAVE WE BEEN? -- A HISTORIC LOOK AT SIRE EVALUATION - Dr. Everett J. Warwick, USDA-SEA, Beltsville, MD.
	FIELD DATA PROGRAMS FOR SIRE EVALUATION - Dr. Peter Burfening, Montana State University, Bozeman.
	DESIGNED SIRE EVALUATION PROGRAMS - Dr. Don Kress, Montana State University, Bozeman.
10:25 - 10:40 a.m.	Coffee Break
10:40 - 12:00 Noon	INTERACTION EFFECTS ON NSE DATA - Dr. Larry Benyshek, University of Georgia, Athens.
	WHAT'S AHEAD FOR SIRE EVALUATION? - Dr. Richard Willham, Iowa State University, Ames.
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	President's Comments - Mark Keffeler
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	MEASURING GROWTH AND CARCASS TRAITS THROUGH NSE - Dr. Larry Cundiff, USDA-SEA, Clay Center, NE.
	GETTING A HANDLE ON REPRODUCTIVE TRAITS - Dr. T. D. Rich, American Polled Hereford Assn., Kansas City, MO.
2:40 - 3:00 p.m.	Coffee Break
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	USING SIRE EVALUATION DATA - Dr. Roy Wallace, Select Sires, Plain City, OH.
4:30 p.m.	Convention Adjourns
6:00 p.m.	BIF Board Meeting

WHERE HAVE WE BEEN? A HISTORIC LOOK AT SIRE EVALUATION

E. J. Warwick[1/]

The invitation of the committee to present this talk is greatly appreciated. It led me to review a great deal of half-forgotten material and brought back to mind a host of personal recollections about developments and many of the people responsible for them. I'm fortunate to have been personally involved in many of the things to be discussed and to have been acquainted with almost all the people concerned even though many of the activities antedated my personal participation.

Undoubtedly, I'll talk about some proposals and activities in a manner that some could construe as being critical of the proponents. This is in no way intended. We've all been through a great learning experience during the past half century. Fortunately, this continues, and I trust that no one will leave here today feeling that the "last word" has been spoken on any subject. Hopefully, someone reviewing a subject such as this a half century hence will read the proceedings of this meeting and ask how the participants could have been so incredibly naive.

The importance of sire evaluation has been recognized from ancient times. However, we will limit our discussion to the approximately last 50 years--a period of time that spans the history of scientific approaches to the problem in beef cattle--with passing reference to some earlier proposals and programs based on show ring records of progeny.

The earliest proposal I've found on a program for beef sire recognition (Winters, 1920) suggested an advanced registry based on "admission of a sire after he had produced a certain number of blue-ribbon youngsters--". Some of you who knew Lawrence Winters in later years might be interested to know that in the same article he stated that "--the writer still has considerable confidence in the judge's verdicts at the leading fairs."

A number of beef breed associations established sire recognition systems based upon show ring winnings of progeny. Perhaps the best-known of these is the Hereford Register of Merit, initiated in 1928 and still active with modification to provide for additional recognition based upon progeny growth and carcass records. The Polled Hereford Standard of Perfection program based on progeny show ring winnings also continues and has been incorporated with progeny performance information into a more broadly based sire recognition system.

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The terms performance testing, record of performance, and sire evaluation have often been used more or less interchangeably. The first proposal (Sheets, 1932) for a Record of Performance based upon objective data was in essence a progeny testing procedure for sire evaluation. It called for individual feeding and slaughter of all test animals. Winters and McMahon (1933) severely criticized the Sheets proposal as being too complicated and entailing the slaughter of too many genetically superior potential breeding animals. They suggested instead an evaluation system based upon rate of gain and a final live grade. They did not explicitly indicate whether the evaluations were be be used for a progeny test evaluation of sires or for selecting superior animals upon the basis of their own records.

Subsequent literature on performance testing and record of performance topics in the 1930's and early 1940's in many cases (Black and Knapp, 1936 and 1938; Black et al., 1938; Knapp and Baker, 1943; Knapp et al., 1942; Knapp et al., 1943; Clark et al., 1943) seems to have either explicitly or implicitly been based on the premise that evaluation would emphasize postweaning and carcass traits and that it would be via progeny test procedures. Other reports, however, by some of the same workers (Black, 1936; Knapp et al., 1941; Knapp and Black, 1941; Knapp et al., 1942) addressed problems of selecting for preweaning growth and its relationships to other traits. For the most part, the questions studied and considered relative to progeny testing were on its accuracy and on such things as numbers and procedures required for establishing significant sire differences rather than on the broader question of how progeny testing could be effectively used in a breeding program.

The landmark paper of Dickerson and Hazel (1944) did much to bring the progeny test question into proper perspective. Although their examples were all with classes of farm animals other than beef cattle, they showed clearly that for most economically important traits in closed populations dependent upon natural mating: "A regular plan of progeny testing is unlikely to increase, and may reduce, progress unless (1) the progeny-test information becomes available early in the tested animal's lifetime, (2) the reproductive rate is low, and (3) the basis for making early selections is relatively inaccurate. These factors are largely beyond the breeder's control, being relatively unchangeable for a particular kind of animal and trait.

"Opportunity for improvement from selection is nearly maximum for most traits when (1) culling is based on individual performance, family average, and pedigree and (2) the interval between generations is kept short. Possible exceptions are weanling traits in sheep and carcass traits in sheep and beef cattle." They recognized the potentials of artifical insemination in the following statement: "The technique of artificial insemination may increase the advantage of using selected progeny-tested sires if the population is sufficiently large and if the reproductive rate of males is increased markedly thereby, as in sheep and cattle." They did not extend their calculations to quantitate possibilities for increased progress from use of artificial insemination. Over time, I believe a general recognition of the potentials developed, but to my knowledge it was not until much later (Warwick, 1960) that any specific estimates of potential increases in progress were published.

The papers of Knapp and Nordskog (1946a,b) reported relatively high heritabilities for several beef traits and they stated: "...it appears that the influence of heredity on gaining ability and also on efficiency of feed utilization by calves may be high enough to make selection, based on individual performance for these traits, effective without the use of progeny testing." These findings, confirmed in at least a general way by many other workers over the next 15 years or so, together with the Dickerson and Hazel (1944) paper and various reports by others, particularly the papers by Lush (1947) on the values of individual merit and family averages in selection, tended for a number of years to focus the emphasis in sire evaluation among both researchers and extension personnel on individual performance rather than progeny testing.

At that time, of course, artificial insemination (AI) was little used in beef cattle and prospects for its ultimate use in purebred beef herds seemed uncertain to say the least. If I interpret history correctly, the real potentials of AI for providing ties between herds, thus permitting comparisons between sires on a population- or breed-wide basis, were little appreciated. This was true even in dairy cattle when AI came into wide use in the 1940's and 1950's with the avowed purpose of genetic improvement through wide use of superior sires. However, records show that genetic progress was slow and that production of progeny of AI sires was only marginally better than progeny of sires used naturally until after the use of contemporary comparisons came into use--first in New York state in the 1950's, and in 1961 in the national Dairy Herd Improvement program.

The first beef cattle Extension publication, of which I am aware, (Guilbert and Hart, 1946) to make comprehensive recommendations on performance testing and sire evaluation emphasized selection on the basis of individuality and pedigree with some, but relatively unspecified, use of progeny performance.

Essentially, all the Extension and beef breed association publications on performance testing or sire evaluation with which I am acquainted, from the 1940's until the first reference sire programs became operational in the 1970's, stressed the use of records on a within-herd basis. Typical of statements on this is one in the 1963-64 TPR brochure of the American Hereford Association: "Since the recorded information has value when applied within herds, the intent is, and the recommendation is, that all information gained through the program be used strictly within the herd where it originated." Another from the 1965 report of the Beef Records Committee goes into a bit more detail: "Record of performance is useful primarily to provide a basis for comparing cattle handled alike within a herd and only secondarily for estimating differences between herds or between groups treated differently within a herd. This is because large environmental differences due to location, management, and nutrition are likely to exist between herds or different management groups within a herd. It is not possible to adjust accurately for these differences. Genetic differences between herds do exist but large environmental differences make the evaluation of such genetic differences extremely difficult."

There are several objectives of central bull tests, but one is to feed a group assembled from several herds in a similar environment on the same rations for a portion of their lives and thus permit evaluation of individuals with reduced herd of origin environmental influences. They only partly eliminate these influences and are today generally recognized as permitting only very limited between-herd comparisons.

The first formal program for sire evaluation through progeny testing of which I am aware was that of the American Hereford Association with the first cattle fed in 1962. The program is based upon breeders sending 8 steer or heifer progeny of sires under evaluation to specified cooperating feedlots. They are fed to prescribed weights and slaughtered, and carcass data are obtained. Breeders are urged to submit progeny of two or more sires if possible. Data on feedlot and carcass performance of progeny of his sires are provided to the breeder together with average data on all cattle in the program. Emphasis is on within-herd use of data. Between-herd comparisons suffer from the same limitations as central bull tests. Over 2000 sires were evaluated in the program through 1977.

Performance Registry International (PRI) initiated the first official sire evaluation in the form of the Certified Meat Sire (CMS) program initiated in 1961. It is based upon performance and carcass data from a minimum of 10 progeny. Prescribed standards for a number of growth and carcass traits must be met for recognition as a CMS sure. The program continues with some modification of prescribed standards and was extended in 1968 to include the optional SUPER CMS category. This involves a contemporary within-herd progeny test of three or more 'nominees'. Any previously certified sire may be listed as a 'benchmark' to produce an additional progeny group for direct comparison with the nominees. Theoretically, continued use of this procedure enables a breeder to place a succession of bulls into senior herd sire position, with each having been compared to a "benchmark" breeding value within the herd. To date, 503 sires have been certified in the original (GOLDEN) CMS category and 33 in the newer SUPER category.

The 1960's were years of great activity in the beef cattle performance testing arena. Extension-sponsored or -related programs were active in 35 or more states. Most breed associations had adopted programs. With the exception of the Hereford program cited earlier, all these emphasized individual evaluations. In addition, most suggested that breeders pay attention to progeny performance, especially for carcass traits.

During this same general period, one major packing company initiated a beef improvement project that included progeny testing. Artificial insemination organizations engaged in progeny testing programs to identify superior sires for wide use.

Methods of evaluation and terminology used in programs varied tremendously. In an effort to encourage "speaking the same language," an informal Beef Records Committee was organized about 1962 with Dr. Frank Baker, at that time Federal Extension Animal Husbandman in Washington, spearheading the activity. This Committee prepared a report issued in February 1965 that did much to encourage uniformity in recording and reporting performance records. This report was devoted principally to measuring performance characters of individuals and considered progeny testing primarily in relation to carcass characters although it is mentioned as a possibility for evaluating growth. The report does not mention artificial insemination or the possibility of tying herds together genetically.

In the same general period, the success of Dairy Herd Improvement programs led to strong pressures for organization of similar programs for beef cattle performance testing under Government auspices. Other segments of the industry recognized needs for nationally coordinated programs but favored other approaches. These influences led to a meeting in Denver on January 14, 1967, with the stated purpose of discussing "The Need and Opportunity for a National Organization with International Relations to Keep Records of Performance of Beef Cattle." Regarding the meeting, the leaflet announcing it stated: "While it was called under the auspices of Performance Registry International and the Montana Beef Cattle Performance Association, the outcome is entirely with the consensus of the various organizations who are represented at the conference." Degree of interest is indicated by an attendance of 173 people.

Ferry Carpenter served as chairman. There appeared to be consensus on three things: (1) there was need for national program coordination, (2) the industry favored a private vs. governmental sponsorship, and (3) there was need for a national organization to serve as a coordinating but _not_ as an operating entity.

At the meeting, an _ad hoc_ committee of 22 people was formed, partly of volunteers, partly of draftees, under the chairmanship of Frank Baker. This group met that night and laid the foundation for organization of the Beef Improvement Federation (BIF).

When BIF became a reality in early 1968, one of the first committees appointed was on "National Sire Evaluation Programs." The charge to the committee was as follows:

"1. There is need to evaluate the current National Beef Sire Evaluation Programs of BIF member organizations with careful attention to cataloging the strengths and weaknesses of each program.

2. There is need to study the long-range needs of the beef industry in National Sire Evaluation Programs.

3. There is need to examine and evaluate the results and experiences of other organizations in conducting National Sire Evaluation Programs on animals of economic significance."

The Committee was active and prepared an 11-page report that was reproduced in the 1969 BIF Proceedings. The report stressed needs for records of individual performance and performance of ancestors and collateral relatives as well as of progeny as key components of National Sire Evaluation Programs. Stress was placed on the existing uncertainties regarding heritability of between-herd differences as a hindrance to realistic comparisons of sires in different herds. The possible use of reference sires to permit cross-herd comparisons was mentioned but the idea was not developed, and no specific recommendations were made on it.1/ A list of general recommendations was presented in which needs for expanded recordkeeping and greater use of artificial insemination were cited.

The Committee was reappointed in 1969 and served as a focus for discussion of a wide variety of industry viewpoints on potential components of national sire evaluation programs. Numerous talks were given by the committee chairman and other committeemen to interested groups. A symposium was arranged for the 1970 BIF meeting at which a spectrum of views was presented.

The BIF Board reappointed the committee in 1970 with an expanded membership and an explicit charge to: "...develop a set of guidelines for a national sire evaluation program to be presented and discussed at the BIF meeting in Kansas City in April 1971."

During the winter of 1970-71, inputs from each committeeman were solicited, and at least three draft proposals authored by either individual committeemen or the chairman were circulated. Some sharp differences of opinion were encountered.

1/ I have been unable to definitely determine the origin of the reference sire concept. At Pennsylvania State University, 5 Polled Hereford sires were progeny tested in 1963, 6 in 1964, 6 in 1965 and 5 in 1966; one bull was used in all years as a reference sire. Were others using a similar procedure at an earlier date? Repeat use of sires as a check on progress in selection experiments has had limited use in research and could be considered a type of reference sire approach. For example, semen of Line 1 Hereford bulls was frozen at Miles City, Montana, in the 1950's and used recently in tests to compare progeny of current bulls with those by bulls several generations earlier. I believe Paul D. Miller, then of Cornell University, was the first, about 1969, to envisage and develop analytical procedures for systematic use of reference sires to develop ties between herds and to permit national rankings of progeny tested bulls.

With time running out, it was obvious that we couldn't have a full committee meeting before the April BIF meeting and that differences of opinion likely couldn't be resolved by correspondence. Therefore, as chairman, I made arrangements for Dick Willham, Paul Miller, and me to meet at Ames the week before to the BIF meeting. In 2 days, we hammered out a draft. Technical aspects were mostly by Willham and Miller. It was presented to the full committee the next week and adopted with only minor changes. Later, the BIF Board adopted the report that has essentially served as a policy document since that time.

The rest of the world, of course, hadn't been standing still while the BIF committee deliberated. Some of the BIF committeemen were also concurrently advising with breed associations, and two programs based on the reference sire concept and in accord with the BIF recommendations were announced shortly thereafter.

Another concurrent development was the introduction of the exotic breeds to the United States. Bulls were few in number, and were all used artificially, and most were used in many herds. The American Simmental Association from its inception required performance records for registration. This combination, providing both ties between herds and a large volume of performance records, set the stage for sire comparisons using adaptations of dairy sire evaluation methods. In early 1972, this association published what I believe to be the first sire summary for a beef breed in the U.S. Thirteen bulls were included in the first summary based on 6,778 progeny records submitted during the period January 1, 1969, through January 10, 1972. Subsequently, the reference sire concept was introduced into this program. Any sire with minimum prescribed numbers of progeny in a minimum number of herds or with a minimum number of contemporary groups is designated a reference sire. Initially, requirements were at least 500 progeny in 10 or more herds. Current requirement is 300 progeny in 25 or more contemporary groups. Breed directives state that at least one reference sire should be included in each contemporary group.

The following breed associations now have National Sire Evaluation Programs based on the reference sire concept:

Date of Initiation	Association
1971	American Polled Hereford Association
1971	American Simmental Association
1972	American Angus Association
1973	North American Limousin Foundation
1974	American-International Charolais Assn.
1974	American Hereford Association
1974	American Shorthorn Association
1975	American Maine-Anjou Association
1979	Red Angus Association of America
1979	American Tarentaise Association

Although these programs follow the basic principles of the reference sire approach, they have adopted different procedures as regards relative emphasis on field data use and dependence upon designed tests and in degree of direct supervision by the associations involved. With time, there have been changes in programs of several associations. Since these somewhat differing approaches are the topics of discussion by speakers that follow me, I'll not go into any discussion of them.

Considerable progress has been made in most of the programs. I do not have data on all of them, but as of February or March, 1980, the following numbers of bulls have been reported as completing various phases of tests with required numbers of progeny:

Polled Hereford - 160 sire progenies complete through slaughter with 90 more in some phase of testing. All testing is in association-sponsored test herds. Presently, bulls are required to have progeny in two or more test herds.

Angus - 264 sire progenies complete through slaughter. All testing is now in association-sponsored herds. Additionally, there is a purebred option not requiring slaughter.

Simmental - 595 sire progenies with weight data through weaning or yearling age, 63 with slaughter data, and 140 with weaning weight data on daughters. Varying numbers have progeny records relative to other types of data. The program is based on field records.

Hereford - 48 sire progenies complete through slaughter with 43 more now on test and scheduled for slaughter in the near future. Those of you attending the American Hereford Association's "Standards for the 80's" conference here in Denver later this week will have an opportunity to learn more about this program and see representative animals involved. It was originally based on only association-sponsored test herds but has now been expanded to include on-farm tests.

Limousin - In tests with progeny of 3/4 Limousin or higher, 210 sire progenies have been evaluated for birth weight, 185 for weaning weight, 120 through yearling weight, and 54 on weaning weights of daughters. The program is based on field records.

Charolais - 70 sire progenies complete through slaughter. Evaluations are based on tests in breeders' herds.

Agriculture Canada has evaluated progeny of over 13,000 bulls of 12 breeds for weight or gain to weaning or yearling age since 1971. The program operates by routinely gathering data in Record of Performance herds. "Best linear unbiased prediction (B.L.U.P.) procedures" are used. 1,051 sires are listed as progeny proven. To attain this status they must have progeny in five or more herds and not more than a prescribed error of prediction. Calving ease scores have been introduced into the program. Carcass evaluation will be incorporated later.

In closing, I feel one point is worthy of emphasis. To date, National Sire Evaluation programs have of necessity been progeny testing programs. Insufficient ties between herds have been available to permit extrapolation of individual and family records to a breedwide basis and thus evaluate prospective sires relative to probable standing within their breed for traits of interest. Breed associations are exploring, and in some cases using or issuing, performance pedigrees that include estimated breeding values. To date, these values are all on a ratio basis relative to the herd(s) or contemporary group(s) of which they are a part.

We may, however, be on the threshold of being able to go to breedwide comparisons. These would be of obvious usefulness. Thus, I hope we will keep our horizons broad and not look at National Sire Evaluation programs as involving only progeny testing.

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FIELD DATA PROGRAMS FOR SIRE EVALUATION[1,2]

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Field data programs for sire evaluation have been in existence many years. In the dairy industry, the sire evaluation program relies entirely on field records and has worked so successfully for so many years that we all know the tremendous genetic progress that has been made in improving milk production in dairy cattle. In the last 10 years, with the importation of exotic breeds from Europe and their extensive use through AI, beef cattle sire evaluation programs using field records have come into existence and many have been very successful.

The purpose of a sire evaluation program is to rank sires for traits that are of economic importance to the breeders. Sire evaluation programs should be of a descriptive rather than directional nature so that the individual breeders can determine their own directions. Further, they should be conducted by an unbiased organization that has no vested interest in the bulls being ranked, this helps to insure the credibility of the sire evaluation. One further benefit of sire evaluation programs that should not be overlooked is that they are very educational. My experience in working with the genesis of the Simmental National Sire Evaluation program, I have found that breeders become interested in using superior sires and they need a lot of education on how to use the sire summary. With this, they will greatly increase their interest and educational level in the principles of animal breeding.

What traits should be measured? Any trait that is heritable and can be measured, can be evaluated in a sire summary. But one must remember that the data are expensive to collect and the more traits that are summarized the more data there are for the breeder to evaluate and the more confusing it can be for the breeder. Further, the more traits a breeder attempts to select for the less selection pressure the breeder can apply to each trait, therefore, reducing progress in each trait. I think that this is one reason the dairy industry has made so much progress in that basically they select for only one trait,

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[1]Published with approval of the Director of the Montana Agricultural Experiment Station, Journal Series No. 1059 .

[2]Invited paper presentation at Beef Improvement Federation Annual Meeting, Denver, Colorado, on April 30, 1980.

milk yield.

The traits commonly found in sire summaries are calving ease traits, growth traits, carcass traits and maternal traits. Calving traits relate to the direct effects of the sire on his progeny's calving ease such as, calving ease and birth weight. Our results from analyzing field records from the American Simmental Association indicate that there is a very low correlation (.26) between sires ranking for calving ease from his progeny from first calf heifers and from second calf and older cows which indicates that bulls should be ranked on results from first calf heifer rather than older cows. Also, sires ranking for birth weight was highly correlated with calving ease in first calf heifers (.74) but not older cows (.29). The growth traits in most sire evaluation programs include 205-day weight (weaning weight), 365-day weight (yearling weight), average daily gain from birth to weaning or birth to yearling, and 18-month weight. The carcass traits, which through the use of sire summaries offer an excellent opportunity for improving traits that are highly heritable but cannot be measured without slaughtering the sire, are generally the following: carcass weight per day of age, yield grade, quality grade and others. In the field data programs, we have found that carcass data is generally the most difficult to record and get into the sire summaries. It takes real dedication on the part of the individual breeder to be sure that this data is collected and sent into the association office processing the records. Although USDA orange tags are available, we have generally found that few breeders have purchased them and fewer yet follow up and get their carcass data into the association to be processed so that it can be included in the sire summaries. One could seriously question the usefulness of quality grade since economics dictate that most animals be fed to the choice grade and time taken to reach each grade is not taken into account. Maternal traits or traits of sires daughters are a place where field data programs can make a real contribution to the genetic improvement in the beef cow herd. The traits that are generally summarized are calving ease and weaning weight of a sires daughters first calves. These are traits that take a long time to evaluate the sire, probably 5-6 years after the bull is born and are limited to measurement in one sex, the females. Use the estimated breeding values for maternal traits using pedigree information, has been proposed as one method to select bulls which are superior for maternal traits, which should be fairly effective, rather than wait for a progeny test. However, as a natural result of the field data programs, the records accumulate on sires daughters and can and should be evaluated as the data becomes available. Generally, designed tests do not yield enough daughters due to the initial number of calves produced, culling and failure to become pregnant to get a good evaluation of maternal traits in sire summary. Many other traits can also be measured, but again, the people controlling the test must remember that the more traits measured, the more confusing it can be for the individual breeders. There has been much interest in summarizing traits on skeletal measurements such as height at the withers, hips or pelvic area, body length, and etc. Reproductive traits such as calving interval are of interest, however, for reproductive traits all data on every animal needs to be reported to accurately summarize these type of traits and in field systems this just does not happen at the present time. Horned or polled progeny could also be reported and summarized if this is a trait of importance and an association could use the sire summary to evaluate whether a bull is homozygous or heterozygous for the polled trait.

In field record programs for sire evaluation, all of the data that is used comes from the breeders own performance testing programs. The breed association processing the data and ranking the sires has no control over the assignment of cows to bulls at breeding time. Further, the association depends upon the integrity of the breeder to supply accurate records for sire evaluation to the association. In the eyes of some people, this detracts from the credibility of the sire summary. Associations need to conduct extensive education programs for their breeders so that they understand the importance of randomly assigning cows to bulls and recording data on all calves produced. Some of the biggest wrecks in field data programs and the most questions raised by bull owners have been the result of the breeders not assigning cows to bulls at random within their herd. If the bull appears too much poorer than what the breeder would expect, they almost always complain that the computer made a mistake. However, if the bull is better than expected, all you see is the advertising about their great bull. In my experience, every time this has occurred I have been able to trace the problem to lack of proper assignment of cows to bulls. However, I think that we as educators and association representatives need to devote considerable effort to educating the breeders using field data programs on the importance of proper assignment of cows to bulls to insure a good test of a young sire and to add credibility to the sire summaries. One of the most important parts of proper assignment of cows to bulls is where and how much reference sires are used.

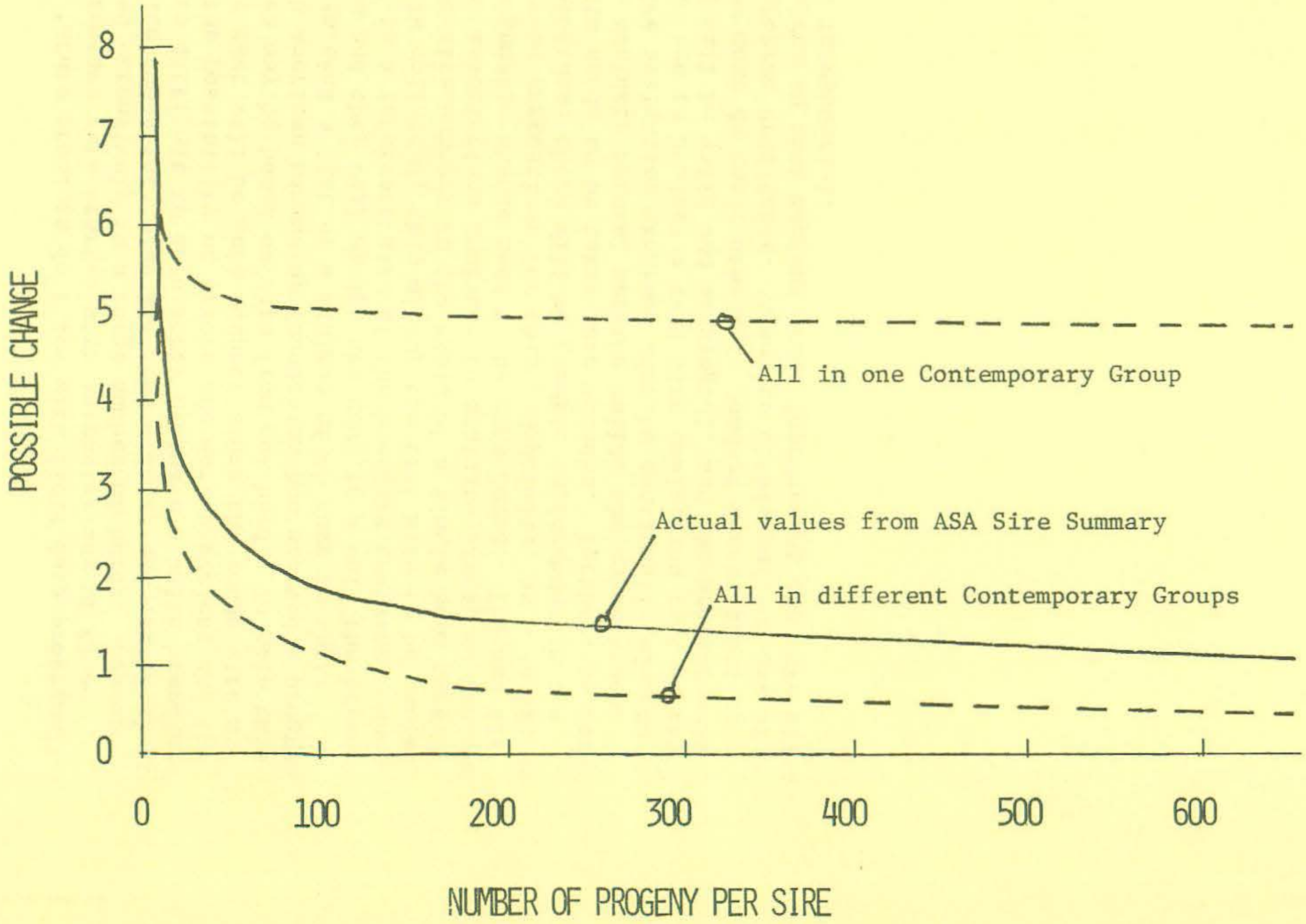
Reference sires are the key to the whole field data program. They are not necessarily superior sires but simply bulls that have large numbers of progeny in many herds or contemporary groups. Reference sires are bulls that are used across many herds and used to tie the herds together so that test sires used in one herd can be compared to young sires in another herd where the reference sire is common to both herds. By having a good estimate of the breeding value of a reference sire his progeny average in the test herd can be compared to his overall average and used to adjust the progeny average of the young sire being tested so that he can be compared to a young sire used in another herd. You can then expand on this and because of the large number of herds that reference sires are used in young sires can be compared to all other bulls that have been used. One of the largest single sources of data loss in field record sire evaluation programs is single sire contemporary groups and contemporary groups that do not have a reference sire. I would estimate that approximately 40 to 50% of all the records reported to the American Simmental Association cannot be used in their sire summary for this reason. Breeders need to thoroughly understand what a contemporary group is, as defined by their associations, at the time the cows are bred so that they can make sure that reference sire progeny will be included properly in each contemporary group.

Contemporary groups are defined as the progeny of bulls (reference sires and test sires) which were mated to a comparable set of cows and the resulting progeny are given equal treatment. Failing to satisfy either of these criteria will cause problems that will bias the results of the test and then the test will not reflect the true breeding value of the bulls tested. Failure by breeders to fully understand how contemporary groups are established can lead not only to bad estimates of breeding values but to much dissatisfaction among breeders as to why their bull was not included in the summary or why the results were not as they expected. Also, one must remember that in field data programs, all bulls with data are evaluated and every time the data is re-run each bull is re-evaluated thus as the number of progeny per bull increases the expected progeny difference may change. As a result of this, a "possible change" value is included with most sire summaries.

The possible change value is a measure of the accuracy, based on the number and distribution of available progeny, of the expected progeny difference in predicting future progeny performance. It indicates the amount of change either plus or minus that is possible in the expected progeny difference when additional progeny are included. Changes as large as twice the possible change value should occur only 1 time in 20. I feel that the possible change value is one of the most poorly understood and least used figures printed in sire summaries. The question most frequently asked by breeders is how do I use the possible change value? My answer is that first, since the expected progeny differences are regressed for number of progeny and heritability of the trait they are directly comparable. Therefore, select bulls that have a high expected progeny difference for the traits of interest and then look at the possible change value to decide how heavily to use a bull remembering that bulls EPD's could go up as well as go down. It is important to remember that with field data programs, sires are re-evaluated every time the sire summary data is run and that bull can rank from one summary to the next. The possible change value indicates how much they could change rank. Using field data, where the records come from a variety of herds and there is no contol over the collection of this data, that large numbers of progeny are necessary to accurately evaluate bulls (figure 1). Where small numbers of progeny (20-30) are used and from 1 or 2 contemporary groups breeders should expect to see some changes in rank after a bull is used in more herds and gets more progeny.

What type of future problems do I see with field data programs? Most field data programs were started with extensive use of AI so the bulls were used extensively in a large number of herds. Now as more natural service comes into play and less wide spread use of AI it is going to be more difficult to accurately evaluate a bulls breeding value because of the possibility of errors are more prevalent and the credibility of the test will be more suspect since the young sire's progeny differences may be based on data from one herd. To help this problem, the North American Limousine Foundation has started a program where a breeder can send a list of a minimum of 40 cows to their association office and they will assign the cows to a bull the breeder wants to test and to a reference sire of the breeders choosing. When the progeny data is collected, this allows the test sire to be ranked and printed in the sire summary on the basis of a single herd test. Secondly, as breed associations continue to evaluate sires, mechanisms for adjusting for genetic change need to be considered. The new BIF guidelines offer good suggestions for this. Hopefully, as a result of sire evaluation programs, there will be genetic improvement in the population and this needs to be taken into account. Further, as more breeders start to evaluate natural service bulls, the association conducting the sire evaluation programs need to continually educate the breeders as to how to conduct a good sire evaluation test so that the data obtained will be valid and meaningful, and the breeder must remember that they must do their utmost to conduct honest tests to keep the entire program creditable. Also, to obtain maximum use of the best proven sires so that maximum breed improvement can take place an open AI policy is essential.

FIGURE 1. REGRESSION OF POSSIBLE CHANGE VALUES ON THE NUMBER OF PROGENY FOR WEANING WEIGHT RATIO.



DESIGNED SIRE EVALUATION PROGRAMS[1,2]

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It is my firm belief that National Sire Evaluation Programs are a necessary part of our genetic improvement programs for beef cattle. Why are Sire Evaluation Programs so important? Firstly, because the portion of the genetic improvement that comes from the sire side is 80% or greater. Secondly, the only way to accurately compare sires raised in different contemporary groups is by way of the progeny test and the progeny test is the backbone of the National Sire Evaluation Programs.

The purpose of National Sire Evaluation Programs is to increase the number of sires that are fairly compared for breeding value for the economically important traits. Some people have found the concept of breeding value (BV) or expected progeny difference (EPD) a difficult one to understand. Breeding value means just what the words say, the value of the animal for breeding as a parent. EPD is closely related to BV in that it is one-half the arithmetic value of BV. Again, its meaning is just what the words say. EPD is the expected difference of a sire's future progeny from average, if he is mated to a random or representative group of cows. Another way that I think is useful to think about the EPD or BV concept is to use the brick wall concept as illustrated in figure 1. Each brick represents a gene and not all genes are of the same size or have the same effect on the trait. Genes that cause the trait to be above average are above the herd average line and genes that cause the trait to be below average are below the herd average line. Therefore, a bull that has a superior EPD or BV would have most of his "bricks" above the herd average line. Note, however, that not all of his "bricks" would be desirable. All bulls carry some undesirable genes. An inferior bull has a preponderance of "bricks" that are below the herd average line and, hence, his EPD is lower than that for the superior bull.

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[2]Invited paper presented at Beef Improvement Federation Annual Meeting, Denver, Colorado, April 30, 1980.

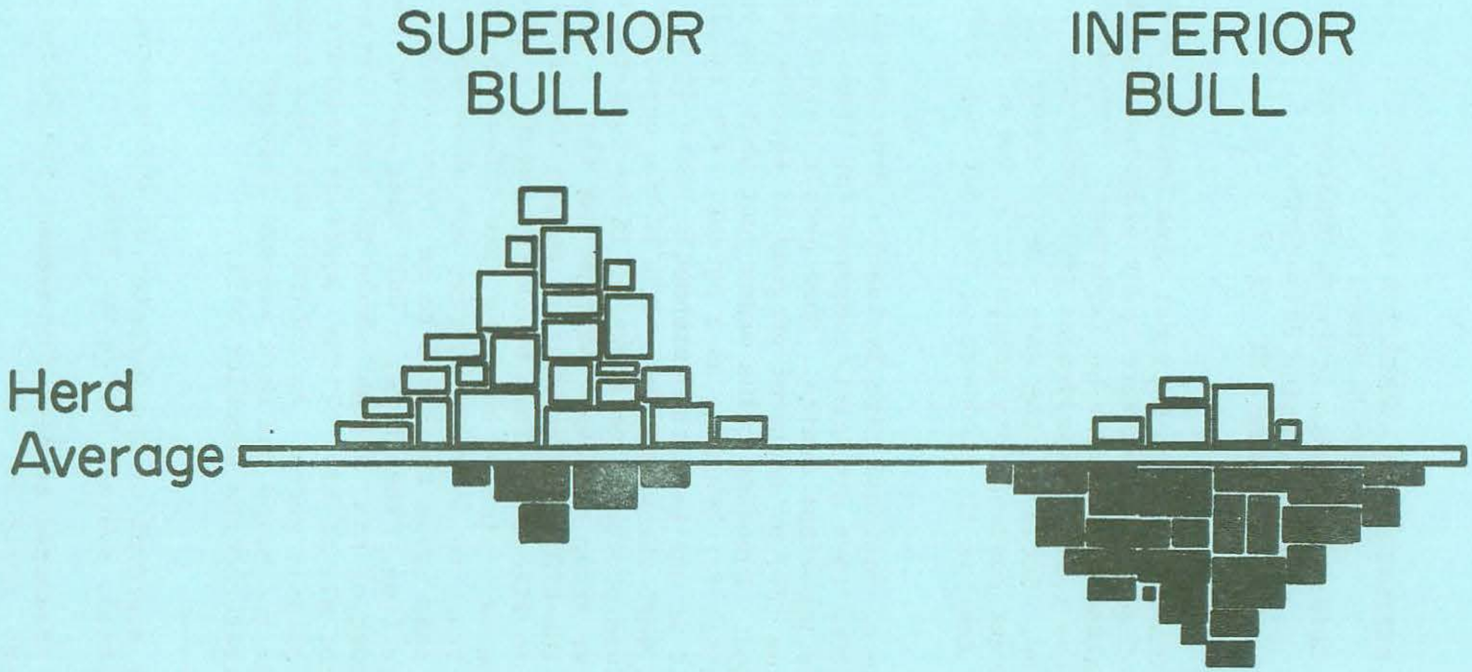

Figure 1. The brick wall concept for depicting EPD where a higher brick wall means a higher EPD. Superior bulls have more plus "bricks" (genes) and have superior EPD's. However, even superior bulls have some "bricks" or genes that are not desirable.

Description of Designed Sire Evaluation Programs in a Nutshell

The first distinguishing characteristic of Designed Sire Evaluation Programs is that an organization specifies the conduct of the program in detail. The organization may be a breed association or one such as the Iowa Beef Improvement Association or the Montana Beef Performance Association. The organization would specify how the records are collected, the number of progeny required per sire, and how the bulls are mated to the available cows. In addition, the organization would specify all or part of the reference sires that are to be used in each group. Other characteristics of Designed Sire Evaluation Programs are that they would use designed progeny tests, use EPD values to compare tested bulls and use reference sires as a method of tying the test herds together.

How it Works Within a Herd

Within an individual test herd or individual breeder herd, several things need to be done to insure that the sires are fairly and accurately compared with one another. Normally, two or three reference sires are used within a herd. The association may specify all of the reference sires or it may allow the breeder to pick one of the reference sires. The number of test sires, of course, varies depending on the number of cows available for the test and could vary from one up to something on the order of twenty. However, it would be more common for half-a-dozen or fewer bulls to be tested in one herd. I can also see many reasons for having more than one test bull.

Which sires are tested? Obviously, not all sires of a breed will be tested because the test program is expensive (current cost of testing a bull is usually about $2,500). Hence, only bulls that show a promise of being superior sires, based on their own performance and/or estimated BV from records on relatives, should be tested.

It is imperative that all sires be mated at random to the available cows. This must be done so that sire progeny averages reflect the EPD's of the sires being tested instead of any genetic differences among the cows. If this is not done, it is easy to determine the outcome of the test before it is even started. Therefore, for a fair test to be done, it is very important that bulls be mated to the cows at random.

BIF has given a minimum number of progeny required per sire and reference sire as shown in table 1. I want to emphasize that these are minimum numbers and that it would be desirable to have more progeny per sire than given in the table. For example, we would want to have the maximum number of progeny from reference sires possible because the accuracy of the test for the reference sires sets the limit on the accuracy of the test for the other sires.

TABLE 1. MINIMUM NUMBER OF PROGENY

Test Bull = 20	
Reference Sire	= 10 for 1 Test Bull
	= 15 for 2 Test Bulls
	= 20 for 3 Test Bulls
	= 25 for 4 Test Bulls
	= 30 for 5 Test Bulls
	= 35 for 6 Test Bulls
	= 40 for 7 Test Bulls

Include records from all calves. It is too easy to convince oneself that the record from a poor performing calf should be discarded because he appears to be sick. The problem is that you don't know where to stop. Hence, records must not be excluded unless it is for reasons that have been predetermined before the test was started.

It is possible that there could be several contemporary groups (equal opportunity groups) within a herd. If this is the case, then care must be taken that all sires are represented in approximately equal numbers in all contemporary groups.

The traits measured could vary from organization to organization. The traits that are normally measured are calving difficulty, growth traits such as yearling weight and carcass characteristics such as yield grade.

In order to make a Designed Sire Evaluation Program work, it must be planned well in advance. The semen on the reference sires and/or the test sires must be ready by the start of breeding season, the mating program must be planned ahead of time, the cows must be cycling before the start of breeding season, the record keeping system must have been decided upon down to the most minute detail, any reasons for not using a calf's record must be predetermined, etc.

Test Herds vs. Breeder Herds

A test herd is one that has been contracted by the organization to conduct the progeny test for the sire evaluation program. Normally, the owner and/or manager of the herd would not have vested interest in any of the sires being tested. In this type of herd, the organization has the maximum amount of control in terms of number of sires, how mates are assigned, and so on. As a result, sire evaluation programs that are conducted in test herds may well have more credibility than those conducted in breeder herds. However, the disadvantage of test herds is that they include very little breeder participation and probably limit the number of sires that are tested in any given year.

A breeder herd would be one in which the owner of the herd has a vested interest in one or perhaps even all of the sires being tested (except, of course, for the reference sires). The controlling organization would give the breeder a list of requirements that must be met in order for the test to be valid. In many cases, this would involve the breeder sending in a list of cows to the organization and the organization specifying the cows that each sire in the test would be mated to. The advantage of this type of herd is that it encourages breeder participation and encourages testing the maximum number of bulls. A possible disadvantage, however, is that of reduced credibility because it is impossible for the controlling organization to have as much control over a breeder herd as it does over a test herd and because the breeder normally has a vested interest in the bulls being tested.

The question arises, then, as to whether a Designed Sire Evaluation Program should include all test herds, all breeder herds, or perhaps a mix of the two. It is my opinion that the best kind of Designed Sire Evaluation Program would be one that had a balance between test herds and breeder herds. Having breeder herds in the program would encourage breeder participation. However, also having test herds in the program would lend more credibility to the program and give an organization the opportunity to further test any sires from a suspect breeder herd.

Reference Sires

Reference sires are a necessary part of any sire evaluation program. They provide the links that tie all of the test herds and breeder herds together (see figure 2). If a herd fails to be tied into the system with a reference sire, then there is no way that sires in that herd can be compared to any other sires of the breed, except for those that have progeny within that herd. In other words, without reference sires there is no way to tie herd averages together as illustrated in figure 3. Another way of looking at it is that reference sires allow us to assess the environmental differences among herds.

Possible Problems

The intent in this section is to indicate some possible pit-fall areas. The intent is not to discourage sire evaluation but to make sire evaluation more effective.

The first and foremost problem is that the beef industry needs sire evaluation programs in more breeds. I conducted a survey of the associations, by letter, and a frightfully low proportion of the breed associations are sponsoring National Sire Evaluation Programs. I know that it takes a lot of time and effort, but like so many things that take a lot of time and effort, the pay-off makes it all worth while. This is something that must be done by the breed association for the individual breeder because the individual breeders cannot do it by themselves.

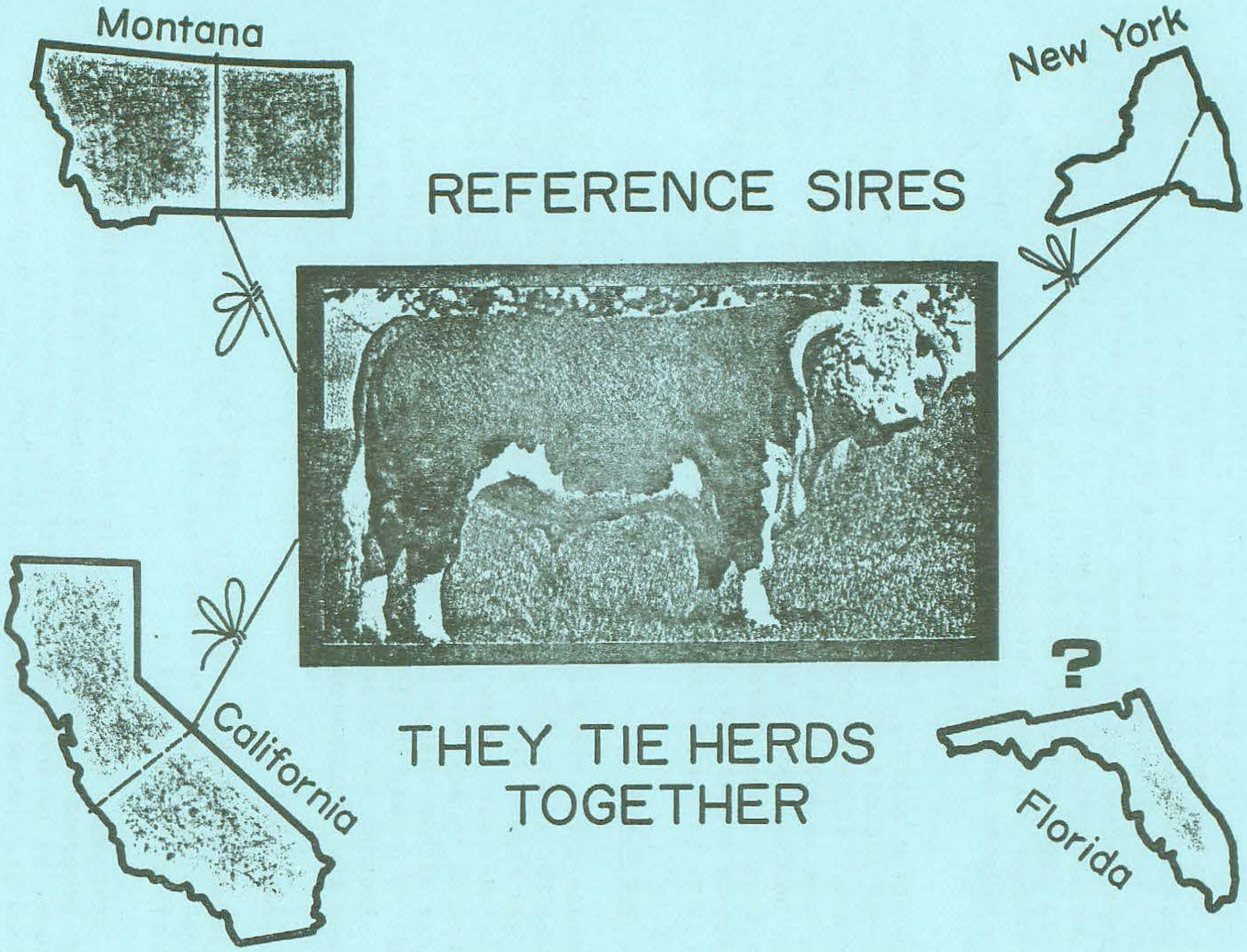

Figure 2. The reference sire system ties herds together, even those that are in different states. Herds that are not tied into the system, such as those in Florida as illustrated here, cannot be included in the sire summary.

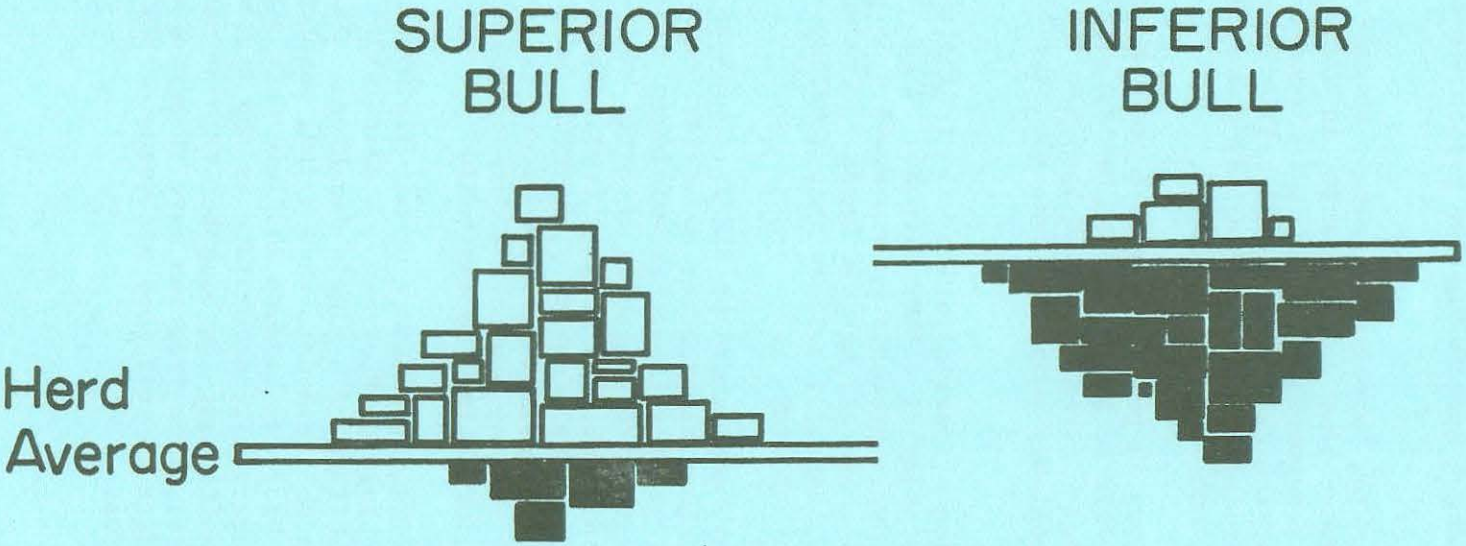

Figure 3. When there are no reference sires to tie herds together, inferior bulls may appear to have EPD values (brick walls) as large as those of superior bulls. The problem is that the baselines (herd averages) are different.

A second problem is that more bulls need to be tested. To date, the most bulls tested in a designed program by a single breed is about 250. More bulls would give breeders greater opportunity to apply selection pressure. A related problem is that more breeders need to participate in the programs. For example, a high proportion of the bulls listed in the 1980 Angus Sire Evaluation Report are owned by AI studs.

A possible problem is low reproductive rate. Normally, the AI is done during a fairly short time. As a result, in order for the conception rate to be at a reasonable level, it is imperative that all cows are cycling, that the AI technician is well trained and experienced, that the heat detection is accurately done, that the semen is of good quality, etc.

Failure to have an open AI policy is also a problem to National Sire Evaluation. The pay-off to National Sire Evaluation is the extensive use of the superior sires. Without open AI, the high EPD sires cannot be used extensively enough to take adequate advantage of the pay-off.

How about the question of participation vs. credibility? I believe there is a real problem at either extreme. If an organization has all test herds, there will probably be a sacrifice in participation. However, if an organization has all breeder herds, there may be a sacrifice in credibility. Hence, I believe that a balance of the two is the way to optimize the program.

The number of progeny recommended by BIF is a minimum. Efforts should be made in sire evaluation programs to achieve numbers of progeny per sire that are greater than these minimums. Figure 4 shows how the possible change (PC) value is effected by number of progeny from test sires and number of progeny from reference sires. The PC value is a measure of the accuracy with which the EPD was estimated, and smaller PC values mean greater accuracy. Any effort to increase the number of progeny produces a corresponding decrease in the PC value and this, of course, is desirable.

Some traits are difficult to measure or not measured at all in Designed National Sire Evaluation Programs. I am thinking in particular of traits like maternal ability of a sire's daughters. This is an area where programs based on field data have a real advantage over Designed Sire Evaluation Programs because in field data programs records on daughters automatically accumulate in the system and when the number of records is sufficient the daughter records can be summarized. However, Designed Sire Evaluation Programs have an advantage over the programs based on field data in that they are doing a better job with the carcass characteristics.

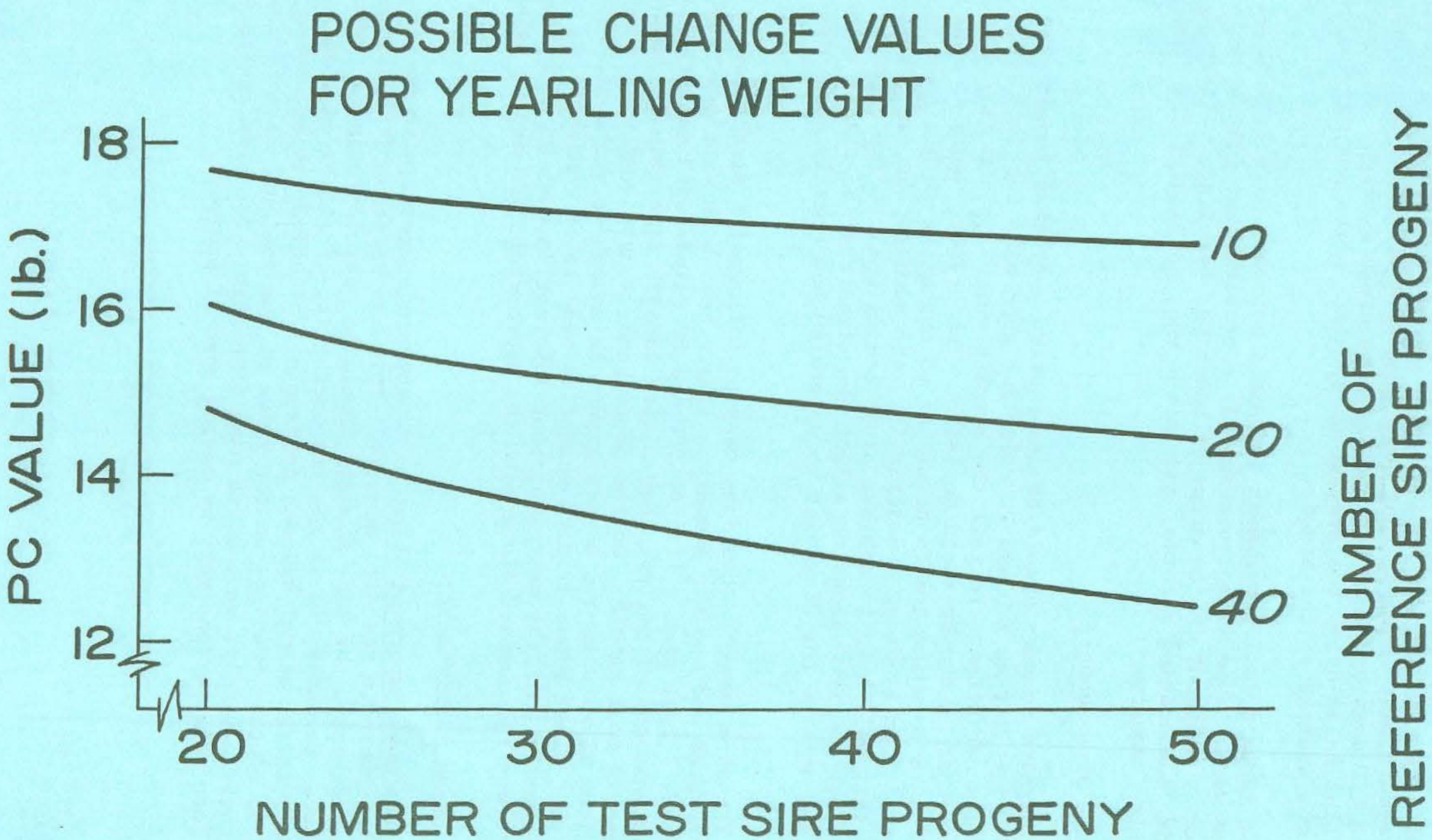

Figure 4. The PC value gets smaller as the number of progeny from test sires and from reference sires gets larger.

In Designed Sire Evaluation Programs, the average of the test sires is greater than the average of the breed (figure 5) and this is not the case with the field data. This is not necessarily a problem but breeders must remember that just because a test sire has a below average EPD does not mean that he is below breed average. It simply means that he is below the average of the test sires and may well be above the average of the breed.

It takes a real commitment to make a National Sire Evaluation Program work. This is not necessarily a problem, but just a reminder. It takes commitment in the areas of planning, breeding, collecting records, summarizing records, and in the end, publishing the results in a sire summary.

The Sire Summary

The sire summary should be descriptive. By that I mean that it should just list an EPD and PC value for each sire for each trait. It should not attempt to tell the breeder which sire he should use because that is the breeders decision. The breeder needs to make the decision as to which traits he wishes to emphasize in his selection program. Then by using a descriptive sire summary, he can identify sires that will help to achieve his breeding goals. The breeder should use the EPD values to select the sires that he wishes to use and then utilize the PC values to determine how heavily each sire is used.

The sire summary should be easy to follow with directions on how to interpret and use the summary. I have seen both extremes. On the one hand, I have seen a list of EPD and PC values with essentially no explanation. I believe that a sire summary like this is essentially useless to most people. On the other hand, I have seen sire summaries that look like books and a mere glance is enough to scare off most readers. These kinds of sire summaries need to be condensed so that they contain only the most important information such as directions on how to use the summary along with the appropriate EPD and PC values.

Using the Results

The most important thing is to encourage breeders to use the results shown in the sire summary. This can be accomplished in several ways. Firstly, the sire summary should be easy to follow as stated earlier. Secondly, it is the responsibility of all breed associations, as well as all animal science departments of universities, to do their best to educate breeders on the value of the National Sire Evaluation Programs. Thirdly, we need to make it possible for breeders to use the best sires extensively by having open AI programs.

AVE. TEST SIRE > BREED AVE.

Figure 5. In Designed Sire Evaluation Programs, the average test sire is normally above breed average. This occurs because sires are usually not entered in designed tests unless they show promise of being superior sires.

THE EFFECT OF GENOTYPE BY ENVIRONMENT INTERACTION ON NATIONAL SIRE EVALUATION PROGRAMS

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The comparison of bulls reared in different environments is paramount in any program of genetic improvement in beef cattle. Geneticists and purebred cattle breeders have long been aware of the confounding of genetics and environment in traditional within herd beef cattle improvement programs. The development of central test stations to more accurately separate genetic effects from environmental effects is evidence of this awareness. The development of National Sire Evaluation programs by various breed associations further exemplifies the interest of cattle breeders to more accurately predict the breeding value of sires. These NSE programs represent the best technology now available for predicting the breeding value or genetic worth of a sire.

If sires are to be used in a nationwide artificial insemination program the necessity of their "Expected Progeny Differences" being applicable to a wide range of environments is obvious. Generally, the differences predicted between sires from the NSE programs can be assumed to be the same for various environments unless "significant" genotype by environment interactions exist. The word significant does not imply simply statistical significance but rather interaction effects of such magnitude as to disrupt the sire EPD's from NSE programs. Genotype by environment interaction may effect results from NSE programs in two ways: 1) there may be changes in the magnitude of differences between sire EPD's from one environment to another, 2) there may be a reranking of sire EPD's from one environment to another. The second consequence is obviously of more importance. The latter situation arises when comparing two sires, call them A and B, in two environments say 1 and 2. The sires on the basis of their EPD's are ranked A over B in environment 1 and B over A in environment 2.

Some Evidence for Sire Interactions. Evidence for sire interactions is obtained from the usual statistical analysis of variance for mixed models. The use of genetic correlation for the same trait in different environments to indicate the importance of genotype by environment interaction was first discussed by Falconer (1952) and extended by Dickerson (1962) and Yamada (1962). This genetic correlation is the correlation of breeding values for a particular trait measured under different environments over a particular set of sires. As indicated by Falconer (1960) a trait in two different environments is regarded as two different traits. The differing environments may require somewhat different physiological mechanisms and thus somewhat different genes for high performance. For example, the differences in growth rate on a low TDN diet (pasture conditions with grain supplementation) may be primarily a matter of feed efficiency, whereas on a high TDN diet (feedlot conditions, high concentrate diet) it may be principally a matter of appetite. If the genetic correlation is high (close to unity) then the performance in differing environments is nearly the same trait determined by nearly the same set of genes. A low correlation would indicate different traits determined by different sets of genes. This genetic correlation approach has been used in most of the current research concerned with sire interactions.

Buchanan and Nielsen (1979) studied several sire by environment interactions including sire by sex of calf for birth weight and weaning weight in Maine-Anjou and Simmental cattle. The range for genetic correlations of sire breeding values across sexes for birth weight and weaning weight was found to be .56 to .98. The generally high correlations found in the study would indicate that sires could be progeny tested accurately using either male or female progeny. Several other researchers have reported similar results for sire by sex interactions in domestic breeds of cattle (Koger and Knox, 1945; Pahnish et al., 1961; Bradley et al., 1966; Tanner et al., 1969; Thrift et al., 1970 and Wilson et al., 1976). Significant sire by sex interactions for weaning weight were reported by Knapp and Phillips (1942) and Wilson et al. (1969).

Sire by birth year of calf interactions were studied for several traits by Pani et al. (1971, 1973) in Hereford cattle. Results from these studies indicated that sire by year interactions were not important for birth weight, preweaning average daily gain or 210 day weaning weight. In the later report significant sire by year interactions for postweaning performance were shown for male progeny but not female progeny. Male progeny were maintained under feedlot conditions whereas females were maintained on pasture.

Buchanan and Nielsen (1979) reported a significant sire by season of calving interaction for weaning weight in Maine-Anjou cattle. The correlation of sire breeding values over seasons was .71.

Significant sire by breed of dam interactions for weaning weight have been reported by Benyshek (1979) in Limousin cattle. Massey and Benyshek (1980, unpublished) found similar interactions for birth weight, preweaning average daily gain, postweaning average daily gain and yearling weight. These interactions were shown when purebred Limousin sires were mated to Hereford and Angus dams. The genetic correlations of sire breeding values when mated to different breeds of dams ranged from .27 for yearling weight to .81 for birth weight. The interactions were not significant when the sires were mated to Limousin-Hereford or Limousin-Angus crossbred dams.

Sire by region of the country interactions have been investigated by Buchanan and Nielsen (1979) and Tess _et al_. (1979). The first authors reported significant sire by region interactions for birth weight and weaning weight in Simmental and Maine-Anjou cattle. The correlation of sire breeding values across regions ranged from .30 to .80. Results from the same study indicated that the sire by herd within region interaction might be of importance for weaning weight. The study reported by Tess _et al_. (1979), also with Simmental cattle, did not show significant sire by region interactions for weaning weight. However, these researchers did find significant sire by herd within region interactions. It appeared that the sire by herd interactions were of more importance than the sire by region interactions. The genetic correlations between sire breeding values across herds were small, however, standard errors were extremely large making interpretation difficult. If the low correlations persist in further studies, it would mean that multiple herd progeny testing would be required to accurately evaluate a sire's breeding value.

Results reported by Koger _et al_. (1979) and Burns _et al_. (1979) indicate that significant genetic adaptation to local environments can occur in beef cattle. These researchers found significant genotype by environment interactions for reproductive, birth and weaning traits in lines of Hereford cattle developed in Florida and Montana. This work provides some evidence through a designed experiment that sire by environment interactions may be of concern in breeding programs.

Consideration of Sire Interactions in NSE Programs. It is obvious from the literature that statistically significant sire by environments interactions exist in beef cattle data. The question becomes whether the sire interactions are of sufficient magnitude to warrent consideration in National Sire Evaluation programs. It should be pointed out that only through national progeny testing programs can sires be tested over a wide range of environments to account for the effects of genotype by environment interactions.

In general most of the sire interactions discussed are not going to be a problem in NSE programs. For example, the sire by sex of calf interaction has generally not been significant in most studies. The sire by breed of dam interaction is not a problem since most breeds will progeny test sires with cows of the same breed. The latter may be important if the sire evaluations are to be used for selection of bulls for commercial crossbreeding programs. However, the overall effect of heterosis or hybrid vigor will probably over shadow the small differences due to sire interaction with breed of dam.

The most troublesome interaction would seem to be sire by herd. If this interaction is found to be of sufficient magnitude, the technology is available to provide evaluations which are generally applicable across herds. However, this would not lead to the same magnitude of genetic change as if the interaction was not present. The BIF Guidelines (1976) discuss the inclusion of sire by herd interaction. Henderson (1974) discusses the sire by herd interaction for Best Linear Unbiased Predicting Procedures and this has been extended by Lee (1978). Application of this technology would require multiple herd progeny testing and thus the problem becomes one of how many sires can be evaluated. The single herd progeny testing of sires, with the use of reference sires, would theoretically allow every herd in a breed to test sires with a limited amount of artificial insemination. The requirement of multiple herd testing would result in a dramatic decrease in the number of sires progeny tested. The increased accuracy of multiple herd testing may be completely negated because of the reduced numbers of sires evaluated. That is to say that the genetic change in the breed may be greater if a larger number of sires were evaluated in single herd tests even though the sire by herd interaction is present. A comparison of the two testing procedures is difficult since precise estimates of the correlation between breeding values over herds is required. A determination of the reduction in selection intensity must certainly be made before multiple herd progeny testing is required by a breed. It is possible that sires with superior preliminary evaluations on the basis of single herd tests could be required to go through multiple herd tests. In fact this would happen naturally as a consequence of extended service of these superior sires.

In conclusion, it would appear that more research information is needed with respect to sire interactions. Present information on sire interactions can not be written off as unimportant and most breeds will have to contend with the problem as their NSE programs develop. However, at present it would seem that problems such as getting more sires into the programs and more progeny per sire to reduce sampling errors are of greater importance.

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SIRE EVALUATION DIRECTION[1]

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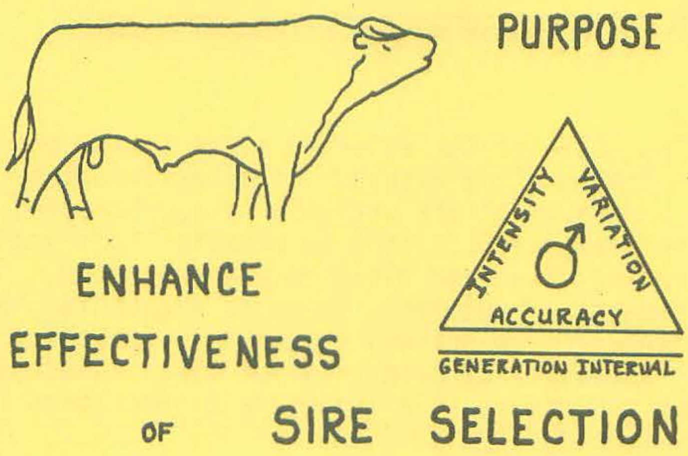
Sire selection and consequently sire evaluation are of paramount importance in all beef breeding programs. The purpose of breed, national sire evaluation is to enhance the effectiveness of sire selection in the breeding programs of all breeders. The goal of such evaluation is the expansion of then number of sires that can be fairly compared on breeding value differences obtained from all sources of



information. The purpose and goal quoted from the BIF guidelines imply that our direction for sire evaluation should be the improvement of sire selection over the beef industry (Willham, 1974).

Consider the purpose. To enhance the effectiveness of sire selection means to increase, over what can be done within small partially isolated sub-groups or herds within a breed, the rate of genetic change per unit of time due to choice of sires in the breeding programs

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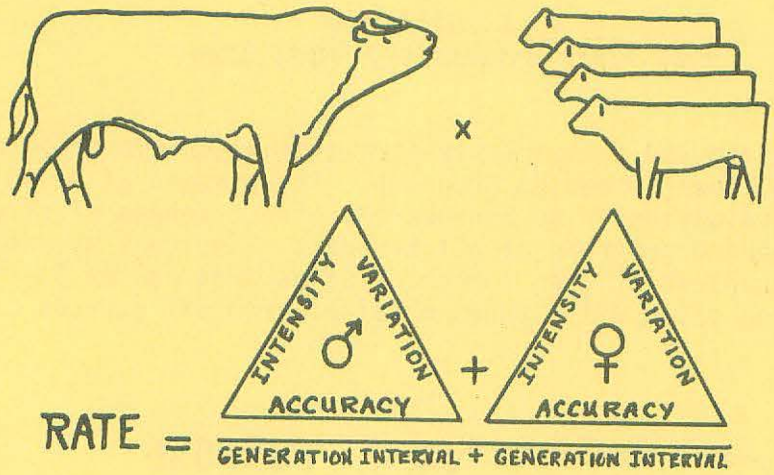
[1]Invited paper presented at Beef Improvement Federation Symposium and Annual Meeting, Denver, Colorado, on April 30, 1980.

of all breeders. Sire selection is involved in the rate of genetic change since the rate can be equated to the sum of the average breeding value of the selected sires and the selected dams all divided by the sum of the average generation interval of the sires and the dams.

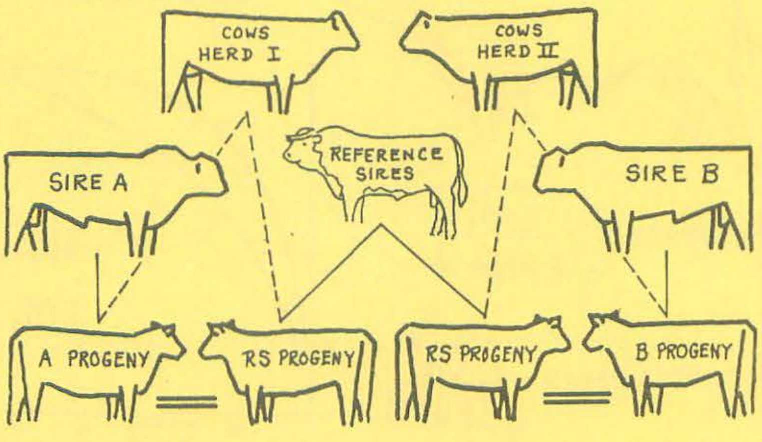


The average breeding value of the selected sires is the product of three quantities. They are the accuracy of selection, the intensity of selection, and a measure of the variation among breeding values. The purpose of sire evaluation is thus to maximize this product that gives the male breeding value and minimize the generation interval of the males at the same time. However, there is antagonism between increasing the accuracy of selection, especially with the progeny test and decreasing the intensity or proportion of sires selected. Also increasing accuracy can result in a longer male generation interval, so compromise is always necessary.

Most ways of improving the rate of genetic change involve improving the accuracy with which parents are chosen. However, the goal of sire evaluation talks to increasing the number of sires that can be compared. Achieving this would make selection more intense and tend to broaden the variation among breeding values. This would increase the rate of genetic change a breeder could make if he could select among thousands of bulls instead of fifty head in his own herd. This is true provided the breeder can exploit the advantage by using any of the bulls through open AI.

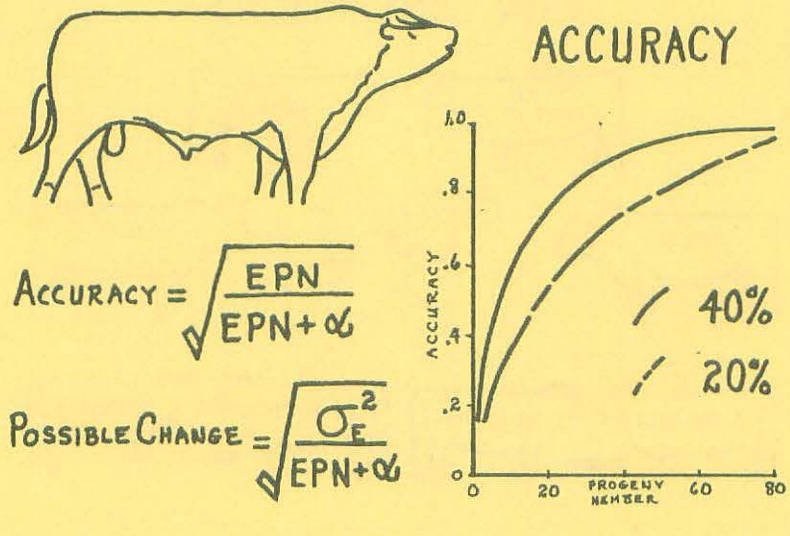
Consider the accuracy of selection. This is the area that great change can be made. Before the classic definition of accuracy can be examined, the expected progeny differences must be unbiased. That is, the expected value of the estimator of breeding value is the true breeding value. Bias or the addition of another factor such as a herd effect would cause an estimator or the difference between two breeding values to contain herd effects as well as the difference between the two breeding values. In sire evaluation, the first issue is to estimate breeding value differences that are unbiased. The way the BIF guidlines suggest this be done is through the use of only differences

FAIR COMPARISONS



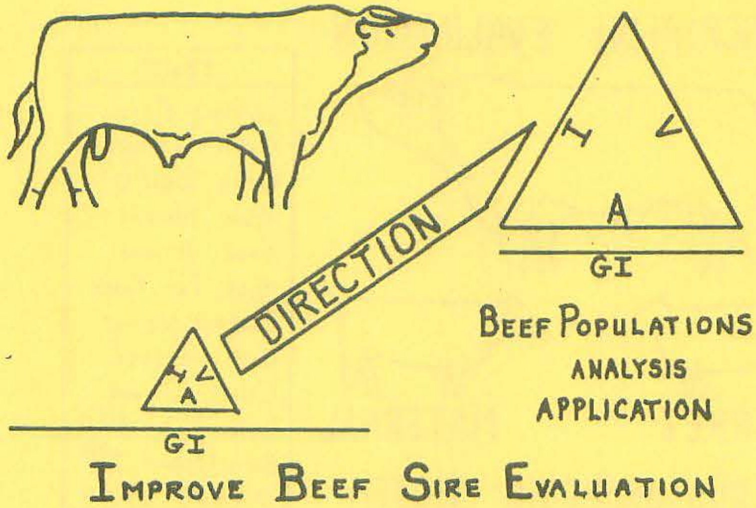
among progeny of sires that are within the same contemporary group. Then reference sires having progeny in numerous contemporary groups are used to tie sire values together over these contemporary groups. In designed programs the sire mates, dams, are chosen at random and all progeny in a group are given equal treatment. Today, large numbers of progeny from a sire are necessary in field data to reduce the chance of bias in estimation of expected progeny differences due to the distribution of the progeny of sires over herds. The first issue, in increasing the number of sires fairly compared, is to do all possible to achieve estimation that does not give biased estimators. Comparison within contemporary groups and the use of reference sires to tie groups together is the rule. Also the choice of which sires to compare is an initial issue.

Accuracy in animal breeding is usually thought of as the correlation between the estimated breeding value and the true breeding value. The correlation would be low indeed when biases of herd and contemporary group effects were included in the estimated breeding values. Supposing that the estimation is done in an unbiased way, there are still differences in the correlation or the measruement of accuracy. Using a mixed model procedure, the accuracy of evaluation is the square root of the effective progeny number divided by the sum of the effective progeny number and the variance ratio (error variance to sire variance). When the trait is highly heritable the ratio is low giving a high accuracy, but when heritability is low to achieve the same accuracy requires a larger effective progeny number (the lead diagonal of the sire equations). A graph of accuracy rises fast as the effective progeny number is increased and then tapers off in rate as more and more progeny are included. This is the law of diminishing returns, so there exists an optimum effective progeny number with a given set of resources.



Accuracy as a correlation and possible change (prediction error) are related. Using iteration to solve the sire equations, the possible change is the square root of the error variance divided by the sum of the effective progeny number and the variance ratio. Multiplying possible change by the reciprocal of the square root of the least-squares variance of the expected progeny difference (error variance divided by effective progeny number) gives the accuracy. Thus, both values, accuracy and possible change, measure how precise the estimator of the expected progeny difference is. Precision in statistical terms has to do with how repeatable the estimator is. That is, small values of possible change indicate that the estimator is closer to the true breeding value then when possible change is larger. Or as repeated samples of progeny are evaluated the better will be the prediction of true breeding value.

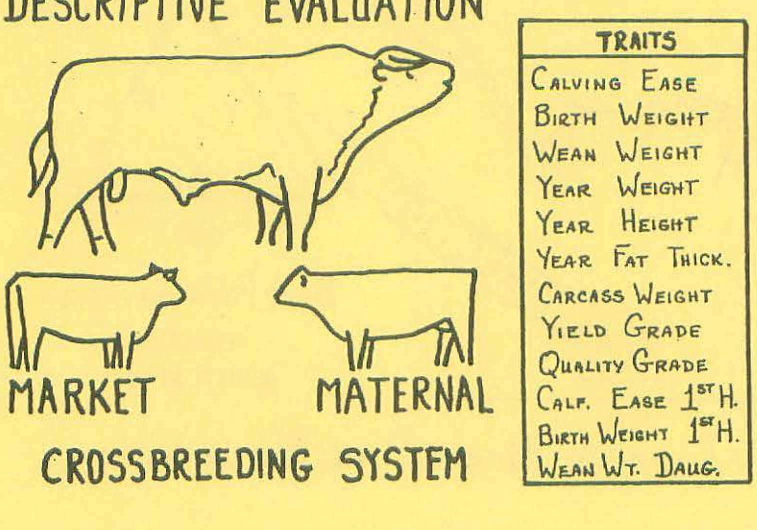
With these concepts in mind, the direction of national sire evaluation is clear. To enhance the effectiveness of sire selection in the breeding programs of all breeders; requires that the accuracy of the selections be optimized commensurate with the use to be made of the sires so selected, that the intensity of selection be increased by maximizing the number of sires fairly compared, that the variation among breeding values be increased by the inclusion of many sires, and that the accuracy of selection desired is achieved at the minimum age of the sires to reduce the average generation interval.



The BIF guidelines for national sire evaluation further state that as more is learned about the beef population through national sire evaluation, all sources of information on breeding value can become more useful. That is, national sire evaluation is a means to an end not an end in itself. To learn about the beef population requires that the available data be analyzed and the results utilized in making sire selection more effective. The purpose of this paper is to study the existing problems in the design and conduct of beef national sire evaluation programs and to examine ways to solve the existing problems through data analysis and application of the results to improve sire evaluation programs for the beef industry.

DESCRIPTIVE EVALUATION

To date, most national sire evaluation programs have been to describe the germ plasm available by reporting the expected progeny differences and possible change values for several traits considered important by the particular breed. The newly introduced breeds have included traits important in their adaptation to current beef systems in the United States. The established breeds have been concerned with growth and carcass, but part of this dichotomy results in part to the newly introduced breeds using field data and the established breeds using designed data for sire evaluation. The opportunity for particular breeds to stress certain traits in their evaluation, in the long run, will depend on the crossbreeding system adopted by the commercial industry. Rotation systems will require the use of breeds acceptable in both market and maternal traits, while the general adoption of specific cross combinations would allow some breeds to specialize. With the majority of beef breeds now having open AI, there will be less direction given by breed associations in sires qualifying for extensive AI use.

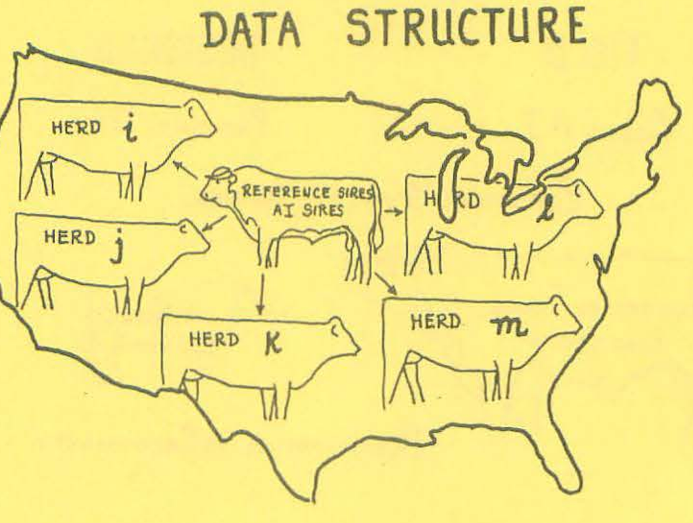


As more is learned through research concerning the role of genetic variation in producing growth and development, possibly better measures of the underlying traits can be developed and measured in national sire evaluation programs. Such might include a measure of mature size and rate of maturity. Linear measures could play a major role in evaluating underlying values of true economic importance.

DATA STRUCTURE

The key to achieving the purpose and goal of national sire evaluation is the distribution of reference sires over the data structure of the breeds. Only by comparing animals within contemporary groups can bias be eliminated from comparisons of genetic merit and only through the production of progeny from reference sires having progeny in several contemporary groups both within and over herds can the comparisons of genetic merit be tied on a comparable basis.

The standard data structure of a breed consists of herds that are partially isolated subgroups of the breed population and within such groups one or several contemporary groups are produced per year. The herds are only partially isolated because of the interchange of sires at least every two years to preclude the possibility of sires breeding daughters. However, this migration is directional being from what breeders classify as elite herds down to the multipliers and on down to commercial use. With open AI as an opportunity, some herds and their contemporary groups can be tied to others through the use of the same AI sire. This opportunity also gives a breed and its breeders the chance to exploit superior sires. Even with the more restricted use of AI because of the gene flow through sons of sires deemed to be superior,

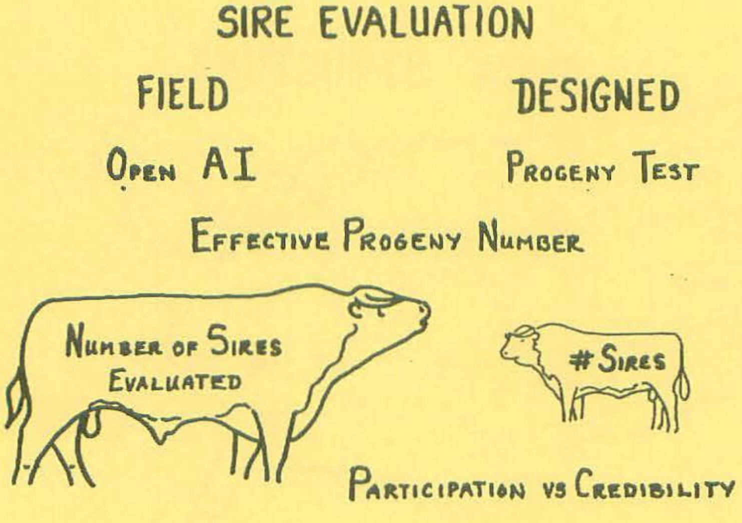


the numerator relationship matrix could be utilized to tie herds, that buy sons from elite breeders together, so that contemporary groups would have relationship ties at least. The goal of national sire evaluation is to expand the number of sires that can be fairly compared using all sources of information.

Breeds now conducting their sire evaluation programs using their field data have already had experience using breed structure. To date, the structure involved using sires widely over the breed through AI with little evaluation being done on sires having progeny in one herd only. As sires are produced within American herds, the data structure will become more like that of the established breeds where AI was not open. Therefore, a new set of problems will develop.

Breeds now conducting designed sire evaluation programs with short experience in open AI do not have a data structure having many ties through popular sires. The use of the numerator relationship matrix might be really useful to glean the available data for sire evaluation.

Most breeds of beef cattle in the United States do not have the resources available to conduct a designed sire evaluation program of the magnitude to supply evaluations on enough sires to service their breed even when there has been significant selection of the sires to test. Designed programs have a place in sire evaluation. They have been a participating educational tool of monumental importance to get the concepts of reference sire use, randomization of cows, and equal treatment of progeny sold to beef breeders. Designed programs can achieve higher accuracy with fewer numbers than the use of uncontrolled field data in sire evaluation. It is interesting that credibility

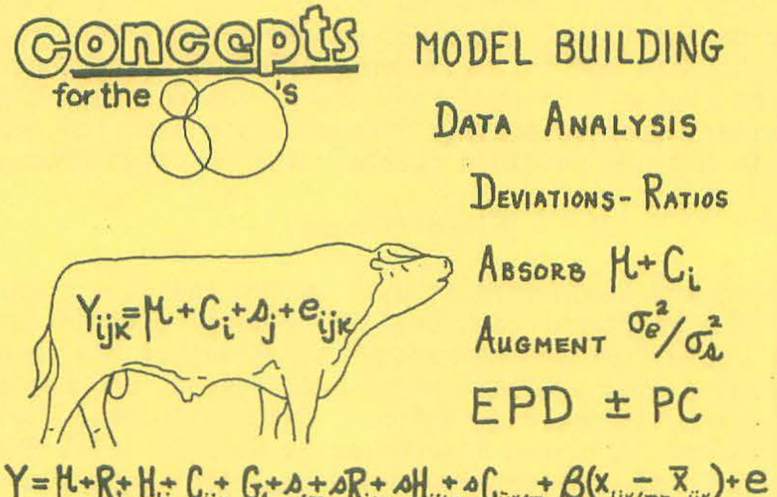


of the test results and participation have some optimum. A breed conducted test has high credibility, but small numbers of sires can be tested. A breeder conducted evaluation has variable credibility, but there is no limit to the number of sires that can be evaluated. Custom costs today could reduce the potential numbers tested. Even with a designed program in existence, there is a need to use all available information contained in the performance program of the breed, especially when open AI has already been achieved.

Unless the sire equations, as currently calculated, are checked to see if each is tied through off-diagonal elements to the other sire equations, the natural grouping of sires with small sets of other sires only will be ignored. The sire equations solve and the results will not be identified by sire groups that are tied together. Thus, all sires will not be fairly compared with all other sires, only those within their group. Caution needs to be raised on this point.

MODEL BUILDING

Model building refers to selecting the model for sire evaluation that produces the most accurate expected progeny differences with high precision or minimum values of possible change (prediction error). To do this requires the analysis of existing sire evaluation data to ascertain the relative importance of sources of variation influencing the sire evaluation results. To date, several blocks of data used for sire evaluation have been analyzed for this purpose (Kress et al., 1977; Nunn et al., 1978; Burfening et al., 1979; Buchanan and Nielsen, 1979; Benyshek, 1979; and Tess et al., 1979).



Beef sire evaluation, due to timing, was able to utilize the mixed model procedure developed by Henderson and his students rather than having to start as the dairy industry did some years ago with sire evaluation techniques comparable to what the beef industry now uses in its breeding value estimation within the various performance programs (Henderson, 1963; Henderson, 1973; and Henderson, 1976). The old methods of breeding value estimation can be soon updated to involve mixed model procedures (Willham and Leighton, 1978 and Slanger, 1979).

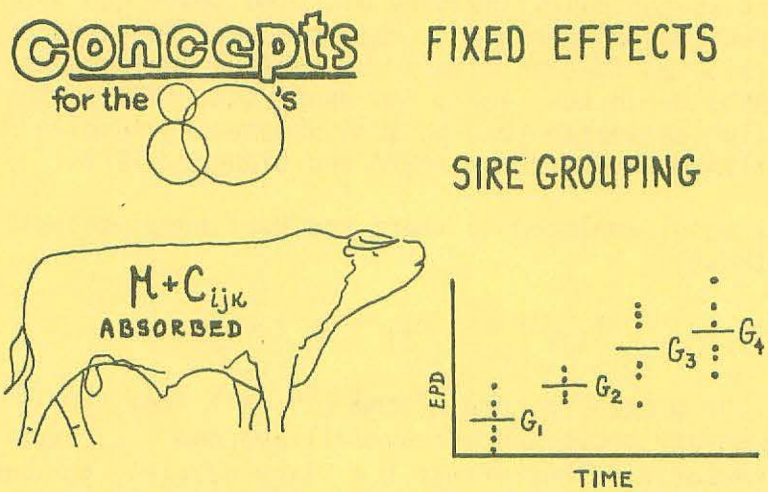
The usual model employed to start the beef sire evaluation reporting was as follows:

$$Y_{ijk} = \mu + cg_i + s_j + e_{ijk}$$

where Y_{ijk} is the progeny record of the k^{th} calf from the j^{th} sire in the i^{th} contemporary group and μ = overall average (a fixed effect), cg_i = the contemporary group effect (a fixed effect), s_j = the sire effect (a random effect with mean = 0 and variance σ_s^2), and e_{ijk} = the random error associated with the particular calf (a random effect with mean = 0 and variance σ_e^2). The model assumes no interaction between the sire and contempory group. Then the $\mu + cg_i$ equations were absorbed into the sire equations giving a set of linear sire equations in which sires are compared within contemporary groups and over groups through the reference sires that tie the groups together. That is, the reference sire equations have numerous off diagonal elements involving the other sires. This system of equations were solved by getting the inverse or by iteration of sire effects after the lead diagonal value for each sire (the effective progeny number) was augmented by adding the variance ratio, σ_e^2/σ_s^2. This gave expected progeny differences that summed to zero and were directly comparable with each other because they were regressed toward zero based on the effective progeny number and incomplete heritability. This was a simple model that could be easily fit to the data and in the absence of data to the contrary it was the model of choice. Consider now the variations possible in arriving at a better model to achieve more accurate expected progeny differences with miminum possible change values or high precision.

Fixed Effects

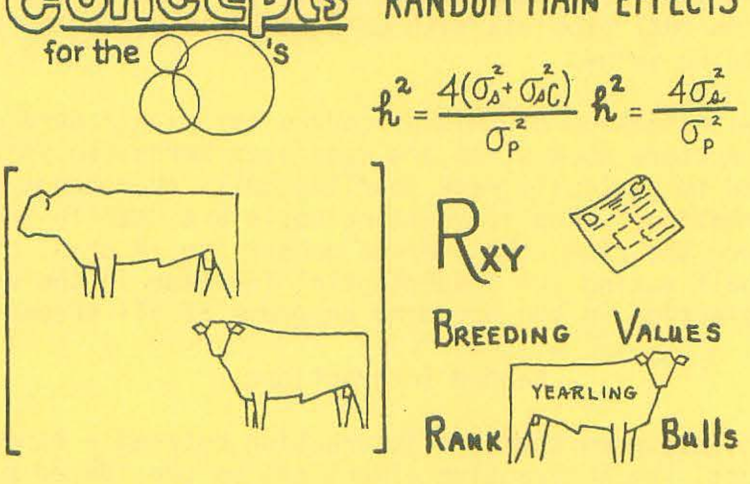
The contemporary group effects used in the analysis are really at the bottom of a heirarchy consisting of several classifications of the data. One could form the heirarchy as regions of the country, herds within region, years within herds and regions, and contemporary groups within years, herds, and regions. Since all these classifications are considered fixed and absorbtion is done in least-squares fashion, absorbtion of contemporary group equations into the sire equations amounts to absorbtion of all the classifications above in the heirarchy. There is no need to consider this heirarchy at all if the objective is to make comparisons of progeny from sires within the contemporary groups.



Henderson proposed grouping the sires on one of several sorts of groupings to account for genetic trend in the population. If sires were grouped by birth date, the sire equations for each group can be summed to form a set of group equations and when the oldest sire group effect is set to zero the solution to the group effects would give the genetic trend in the population. If this is done, the expected progeny differences are the sum of the group effect plus the sire value within group. The sire within group effects are regressed to the particular group mean to which the sire belongs instead of the overall mean. Thus, sire values are regressed to a closer more relevant average. This opportunity needs to be applied in some of the field data sire evaluation programs and maybe the designed ones as well.

Random Main Effects

The important random main effects are those for sires or the expected progeny differences. Few sets of data have been available to estimate the sire variance over regions, herds, years and contemporary groups. Most of the heritability estimates have been obtained from research herds and usually sire differences within contemporary groups have been pooled over the groups to give an estimate of the sire variance. However, the ones that exist are distinctly lower than the research herd estimates (Tess et al., 1979; Benyshek, 1979; and Kress et al., 1977). As argued in the papers, part of this could be due to the nature of field data rather than the heritability really being lower due to the sire by contemporary group interaction exclusion.



An exciting area of addition to the mixed model methodology developed by Henderson is the use of the inverse of the numerator relationship matrix that is put with the sire equations before their solution. This matrix relates every sire with every other sire if they are tied by parentage bonds. The use accomplishes two things. The first is the combining of the various sorts of data on all sires. For example, if a sire has ten sons with a progeny test, this information is used in the estimation of the breeding value of the sire. Conversely, all the sons are sibs of each other so this information is used in estimating the breeding value of all the sons. The second thing the relationships accomplish is to help tie more sires in the analysis together through relationship ties. For example, if a sire has ten sons in other herds, then through the relationship tie all these herds can be included in the sire group where the old sire has progeny in comparison with the majority of other sires, if this is the case.

Note should be made that if the mixed model is used without checking to see which sires are really tied to a group of sires using the off diagonal elements of the sire equations, sire expected progeny differences will be obtained for each sire based on whatever he is tied with which may only be three other sires and not the large group of sires. Without checking ties a sire evaluation analysis can give results that are not directly comparable.

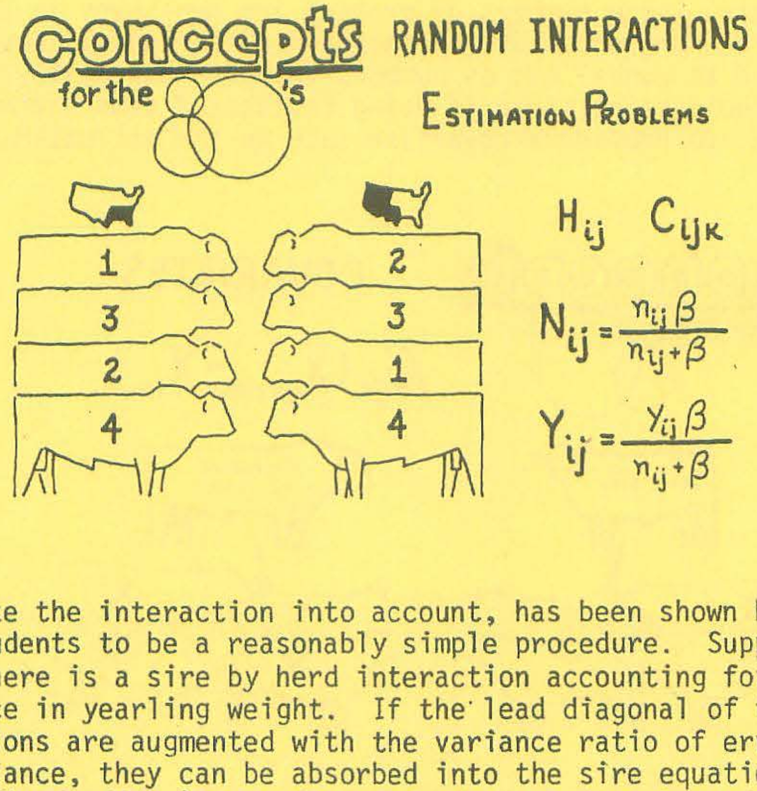
Breed associations have this pedigree information available. Thus, the application of the inverse of the numerator relationship matrix to sire equations can be done in the breed programs. Much can be done to wed the pedigrees with performance to make both files much more useful or synergistic even.

This deliberation on the use of pedigrees leads directly to procedures that can be used within a herd to estimate breeding values for all the potential parents using mixed model procedures (Henderson, 1976; Willham and Leighton, 1978; and Slanger, 1979). This procedure eliminates many of the real problems with using the ratios in the calculation of current breeding values.

The logical extension of this procedure for within herd use is to use the data structure when sires are used over herds, to include the herds of a breed to basically rank yearling bulls over herds on all the available information. Then if yearling bulls are used in enough numbers to reduce the risk, the average generation interval of sires can be cut in half making for a substantial increase in the effectiveness of sire selection in the breeding programs of all breeders.

Random Interactions

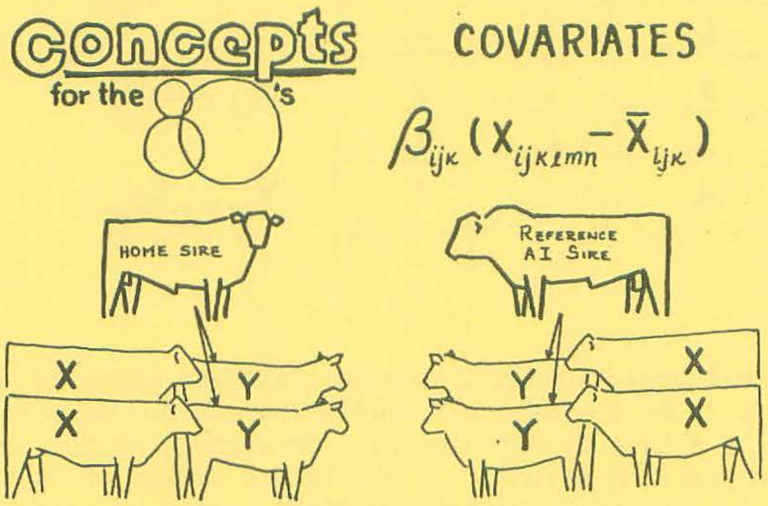
In mixed models when there is interaction between a random and a fixed main effect, the interaction effect can be considered random. Sire values could interact with the fixed effects of region, herd within region, year within herd and region, and contemporary groups within years, herds, and region. Interaction means that the ranking of sires will not be the same in each of the fixed effects. When the interaction is really large, the sire ranking over all the fixed effects may not be the evaluation needed. That is, sires may need to be ranked in their area of use (Dickerson, 1962). A sire evaluation program could do this for geographic regions or particular management systems, but unless the particular herds ranked each sire (and they cannot) little can be done for the remaining fixed effects in the heirarchy. There is some evidence that sire effects interact with regions and other fixed effects (Nunn *et al.*, 1978; Buchanan and Nielsen, 1979; Benyshek, 1979; and Tess et al., 1979). There is real need to study more sets of field data to evaluate the magnitude of these interaction effects. When such effects account for less than 5% of the variation they need to be treated as nuisance effects. That is, they need to be incorporated into the analysis procedure, but sires need to be ranked over all fixed effects. Interactions accounting for more than 5% may suggest that the sire evaluation be designed to rank sires within the regions, management systems, or percentage female. Nothing more but to take them into account can be done with the interaction of sires with herds, years within herds and contemporary groups with years and herds. Real problems exist in the ability of existing field data to give the researcher a true idea of the size and importance of the interactions, since most of the data in any two-way table of say sires by herds is sparse indeed. Not all sires are used in every herd nor can they ever be used even experimentally. But an estimate of the importance of the interaction needs to be made none the less.



To take the interaction into account, has been shown by Henderson and his students to be a reasonably simple procedure. Suppose as an example, there is a sire by herd interaction accounting for some 3% of the variance in yearling weight. If the lead diagonal of the sire by herd equations are augmented with the variance ratio of error to interaction variance, they can be absorbed into the sire equations as are the herd (fixed effect) equations without removing the main effects, which is characteristic of absorbing least-squares equations. Following the absorption lays out beautifully what is done for the values in the sire equations. For each sire by herd grouping calculate the number of progeny times the variance ratio divided by the sum of the number of progeny plus the ratio. The sum of the values for the sire by herd grouping is replaced by the sum times the variance ratio divided by the number of progeny plus the ratio. These numbers are then used to replace the number and sum in the normal absorbtion of herd effects. Using this procedure, the maximum value the new number of progeny can attain is the variance ratio value. The variance ratio will be small (2 or 3) if the interaction variance is large relative to the error variance and large (10 to 12) if the interaction variance is small. Thus, as the number of progeny is increased the value of the ratio is quickly reached indicating, as expected, that many observations in one sire by herd group when interaction is present are not very useful. This accounting for the sire by herd interaction by absorbing the interaction equations, after augmenting them with the variance ratio, is desirable because the lead diagonal or effective progeny number has been adjusted to give a sire due credit for having progeny in many herds compared with one having the same number of progeny but all in the same herd. This analysis procedure needs to be utilized in sire evaluation if the magnitude of the interactions warrant doing so.

Covariates

In field data, large numbers of progeny are necessary in the hope that the biases of non-random use of dams and differential treatment of progeny will tend to cancel out as numbers increase especially in over herd use. It should be possible if using registered dams having some performance data, to provide a covariate such as the estimated breeding



value of the dam based on information available prior to the choice of the dam to be mated to the given sire. This covariate could be included in the sire evaluation model. In fact, a separate regression for each contemporary group might be compared with the overall regression of progeny on dam to study the importance of non-random use of dams.

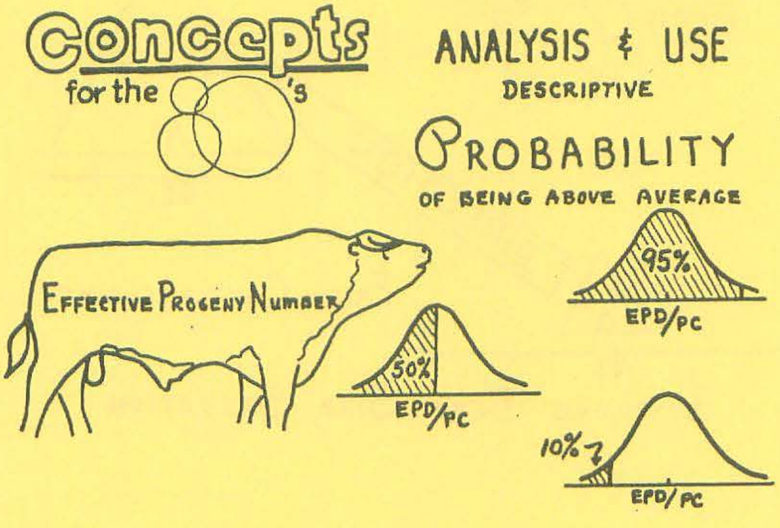
ANALYSIS PROCEDURE

The first decision in sire evaluation analysis is to select the most appropriate model that accounts for the major sources of variance as indicated by prior variance analysis. Yet the model must be simple enough to manipulate. With the number of sires available to rank in even the smallest sets of field data, iteration rather than obtaining the inverse to solve the sire equations will be the rule. This process gives the same values for expected progeny differences, but the calculation of possible change values is different. Using iteration, makes the use of the lead diagonal to divide into the error variance the procedure to estimate the possible change. Therefore, the lead diagonal or the effective progeny number should include as much as it can concerning the data structure so that the possible change values will reflect the better evaluations of sires. Absorbing the sire by herd interaction alters correctly the lead diagonal. The number of sires directly compared influences the effective progeny number, but not completely as does the inverse of the lead diagonal.

UTILIZATION

Consider the purpose. To enhance the effectiveness of sire selection means that the accuracy of sire evaluation be increased both in the bias sense and the ranking sense, the intensity be increased by evaluating fairly a large number of sires and selecting the best, the variance of breeding values be increased by larger numbers of sires, and that the generation interval of sires being evaluated is minimized.

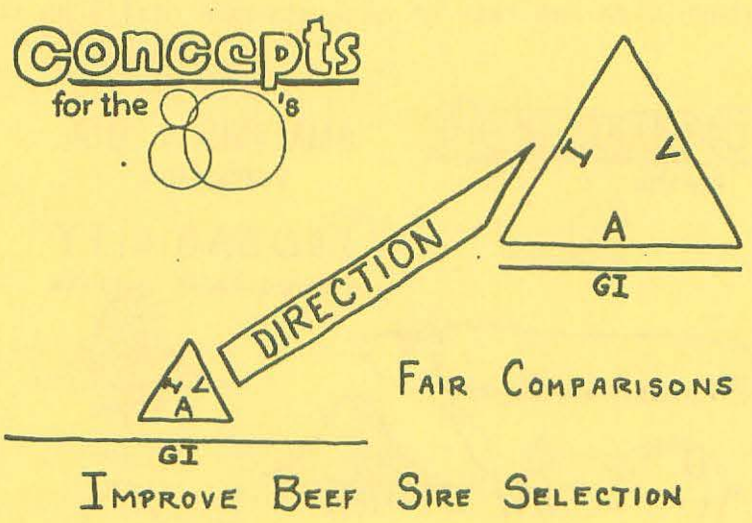
Maintenance of the descriptive nature of sire evaluation seems imperative until more is learned about the biology of the bovine. Then, possibly, simpler evaluations will be possible with fewer traits being evaluated. Mature size and rate of maturity may really be the issues.



Sire evaluation reports or listings must be simple and explained in detail for the many breeders to really make use of them. One of the stumbling blocks still is the lack of understanding concerning the differences reported. If plus sires are used, on the average they will produce plus progeny in all herds. Wanting to know absolute weights still gives problems. Some measure of variance is necessary with each expected progeny difference. Whether it should be the possible change or prediction error or simply the effective progeny number is a question since they do say the same thing. As has been done for the dairy calving difficulty evaluation (Berger and Freeman, 1978), the probability of being above breed average has real merit. The expected progeny difference is divided by the possible change to give a value, that when used to determine the probability, is a useful way to include both expected progeny difference and possible change into one number. Two sires might have the same expected progeny difference, but different possible change; thus one has a 95% probability of being above average while the other has a 60% probability. Then the breeder can decide on the risk he is willing to assume. The better example is one bull with a +50 pounds and another with a +30 pounds expected progeny difference and the first has a 60% probability while the latter has a 95% probability. This shows the usefulness of the concept. Breeders using several sires can better afford to take a risk, while those selecting one sire only for wide use must have a higher probability of the sire being above average.

SUMMARY

Sire selection is the issue. The purpose of national sire evaluation is to enhance the effectiveness of sire selection in the breeding programs of all breeders. To achieve the purpose requires that the



effectiveness of sire selection be enhanced, not just have operating sire evaluation programs. However, the first step in sire selection is evaluation of large numbers of candidates. This paper has been an attempt to study the existing problems in the design and conduct of beef, national sire evaluation programs. The existing data structure was first considered. Having reference sires or all sires used in AI service to tie the structure together is the key issue as well as being a way to exploit the results. Next model building for sire evaluation analysis was considered in some detail. Our real lack of knowledge concerning the relative importance of the various aspects of the data structure to the total variation was suggested and means to remedy the situation were presented. The use of sire grouping, of the numerator relationship matrix inverse, of the random sire by fixed effect interaction absorbtion, and of the use of a covariate to study non-random use of dams were all suggested and discussed. Model choice and the solution of sire equations using iteration were developed. The use to be made of the sire evaluation in sire selection was considered in terms of using expected progeny differences and their possible change values to establish risk criteria. The direction of beef sire evaluation in the next decade will be to utilize, using the best technology, all the information available, both designed and field data, to evaluate sires.

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MEASURING GROWTH AND CARCASS TRAITS THROUGH NATIONAL SIRE EVALUATION

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National sire evaluation can be a powerful tool in breed improvement programs. The traits included in national sire evaluation programs can impact the direction and rate of genetic change within breeds. It is important to consider procedures for trait measurement, heritability and genetic correlations among traits in establishing relative emphasis to place on different traits. These factors will be emphasized in this discussion of growth and carcass traits reported today in national sire evaluation programs.

Table 1 presents traits included in national sire evaluation programs of ten different breed associations in the United States. This summary is based on the prompt and courteous response I received recently from a questionnaire mailed to breed associations in the Beef Improvement Federation.

TABLE 1. TRAITS REPORTED IN NATIONAL SIRE EVALUATION

				WEIGHT							
Breed	Gest. lgth.	Calv. ease	Dau. Wn. Wt.	Birth	Wean	Yrlg.	WDA	Feed eff.	USDA qual. gr.	USDA yld. gr. (cut.)	Ret. cuts per day
Angus		X	X	X	X	X			X	X	X
Charolais		X		X	X		X		X	X	X
Gelbvieh		X		X	X	X					
Hereford				X	X	X	X	X	X	X	
P. Hereford				X	X	X	X		X	X	X
Red Angus	X			X	X	X				X	X
Limousin		X	X	X	X	X					
Pinzgauer				X	X	X					
Shorthorn		X		X	X	X			X	X	X
Simmental		X	X	X	X	X				X	X

Gestation length is included in the Red Angus sire summary. Sire of calf has a significant effect on gestation length. Gestation length of calves is moderately heritable (h^2=.45; Smith, Cundiff and Gregory, 1978). Genetic correlations indicate that longer gestation lengths are associated with heavier birth weight (r_{gg} = .54) and calving difficulty (r_{gg} = .35).

Calving ease is reported in sire summaries of six breeds. A high degree of calving difficulty can not be tolerated in commercial beef production. Not only is the expense of labor at calving a prohibitive factor, but calving difficulty cuts deeply into calf crop weaned by reducing survival and post partum conception in cows. Calving difficulty is low to moderately heritable (Laster et al. 1973, Laster and Gregory, 1973).

Daughters weaning weights are included in sire summaries of three breeds. With this trait, the emphasis is on maternal ability of a sires daughters. Maternal performance is moderately heritable, and strongly associated with milk production. Optimum milk yield is neither maximum nor minimum. Milk yield must be matched with feed resources to maximize efficiency of production.

Consistent with the topic assigned, the remaining discussion will focus on growth and carcass traits. A comprehensive series of growth and carcass traits are included in most national sire evaluation programs.

Growth Traits

Growth rate has long been emphasized in breed improvement record of performance programs. Heritability of weights at different ages from birth to maturity have been high (table 2). Genetic correlations among measures of growth and weight at different ages have been high (table 3) indicating that selection for weight at weaning or yearling ages will lead to increases in weight at other ages as well.

TABLE 2. HERITABILITY OF GROWTH TRAITS

Trait	Heritability (%)
Birth weight[a]	44
Weaning weight[a]	32
Yearling weight[a]	58
18 Month weight[a]	50
Mature weight[b]	60

[a] Petty and Cartwright (1966, Texas Agr. Exp. Dept. Tech. Report No. 5).

[b] From Brinks et al. (1964, J. Anim. Sci. 23:711) and Smith et al. (1976, J. Anim. Sci. 43:389).

TABLE 3. GENETIC CORRELATIONS AMONG WEIGHTS FROM BIRTH TO MATURITY[1]

	Wean. Wt.	12 Mo. Wt.	18 Mo. Wt.	Mature Wt.
Birth wt.	.60	.56	.60	.64
Wean. wt.		.72	.75	.55
12 Mo. wt.			.90	.65
18 Mo. wt.				.80

[1] Weighted averages of estimates by Brinks *et al* (1964, J. Anim. Sci. 23:711) and Smith *et al* (1976, J. Anim. Sci. 43:389).

Increases in mature weight of cows can result as a correlated response to selection for growth at weaning and yearling ages. Increases in mature size of cows increase nutrient requirements for maintenance of the cow herd, which at least partially offset the advantages of more rapid and efficient gains of the progeny slaughtered. Changes in mature size from correlated response to selection for weaning or yearling weight will not be as great as changes associated with direct selection for mature size. Mature weight is highly heritable. Indications are that mature weight supplemented by visual appraisal of differences in frame, size and condition is even more effective in increasing mature size than direct selection for mature weight alone. Direct selection for mature size should be avoided.

Estimates of correlated response in birth weight to selection for weight at weaning and yearling ages have been reported by Koch *et al*. (1974) from a selection experiment involving Hereford cattle at the Roman L. Hruska U.S. Meat Animal Research Center (table 4). Three selected lines and one unselected control line of 150 cows each have been maintained using six to seven sires per line per year. One line has been selected for weaning weight (WWL), one for yearling weight (YWL) and one for an index of yearling weight and visually appraised muscling score (IXL). Birth weight has increased significantly in each line. Correlated

TABLE 4. ESTIMATED GENETIC CHANGE PER GENERATION

Line	Birth Wt.	Wean. Wt.	Yrlg. Wt.	Muscle Score
	LB	LB	LB	UNITS
WWL	1.8	10.6	25.9	-.08
YWL	2.3	7.8	31.0	.02
IXL	2.3	6.9	23.8	.60

Koch *et al*. (1974).

responses for birth weight were 1.8 lb per generation in the weaning weight line and 2.3 lb per generation in the yearling weight and index lines (table 4).

Increases in birth weight lead to significant increases in calving difficulty. Estimates of genetic correlation (table 5) indicate that increases in birth weight lead to increased gestation length, calving difficulty and perinatal mortality (death loss within 24 to 72 hours of birth). Estimates of heritability and genetic correlation are based on variation within breeds. Evidence from studies involving differences between breeds have demonstrated similar relationships for birth weight with gestation length and calving difficulty among breeds.

TABLE 5. HERITABILITY OF BIRTH TRAITS AND GENETIC CORRELATIONS WITH BIRTH WEIGHT.

Trait	Heritability (%)	Genetic correlation with birth weight
Gestation length, days	45	.54
Calving difficulty, %	13	.83
Perinatal mortality, %	5	.55

Smith, Cundiff and Gregory (1978).

The germ plasm evaluation (GPE) program at the Roman L. Hruska U.S. Meat Animal Research Center has included three cycles of sire breeds that were bred by artificial insemination (AI) to Hereford and Angus dams. Hereford-Angus reciprocal crosses (HA) were repeated in each cycle of the program to provide for comparison of breeds included in different cycles. The first cycle involved breeding Hereford, Angus, Jersey (J), Limousin (L), South Devon (SD), Simmental (S) and Charolais (C) sires by AI to Hereford and Angus dams (ranging from 2 to 7 years old at calving) to produce three calf crops (1970, 1971 and 1972). In cycle II, Hereford and Angus dams (ranging from 4 to 9 years old at calving) used in cycle I were bred by AI to Hereford, Angus, Red Poll (R), Brown Swiss (B, predominantly European), Gelbvieh (G), Maine-Anjou (M) and Chianina (Ci) sires to produce two-calf crops in 1973 and 1974. Cycle III involved the same or comparable Hereford and Angus dams mated by AI to Hereford, Angus, Tarentaise (T), Pinzgauer (P), Sahiwal (Sw) and Brahman (Br) sires.

Results from the GPE program for birth weight and calving difficulty are presented in figure 1. Birth weight ranged from 68.6 lb in Jersey crosses to 90.6 lb in Charolais and Maine-Anjou crosses. Breeds siring the heaviest calves at birth tended to exhibit more calving difficulty than breeds siring lighter calves. However, at similar birth weights

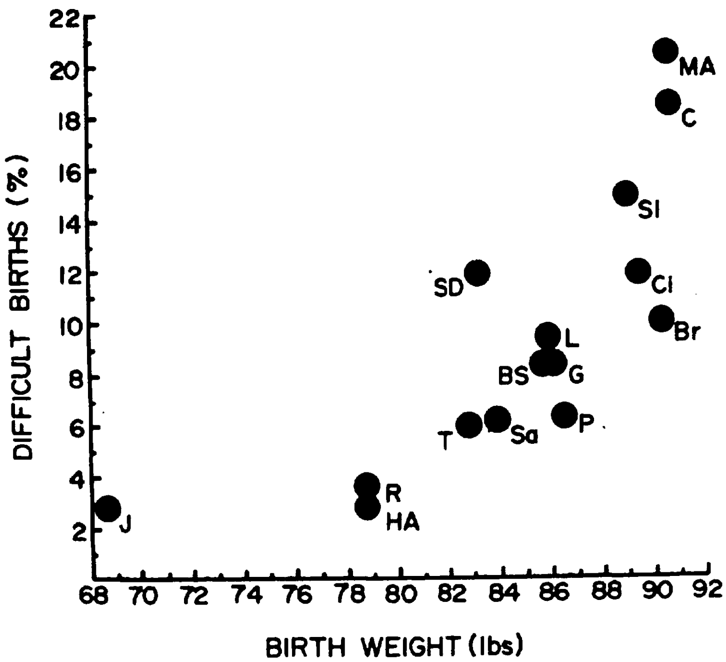

Figure 1. Relationship between calving difficulty and birth weight in calves out of cows 4 years of age or older (Smith, Laster and Gregory, 1976; Gregory et al. 1978, 1979).

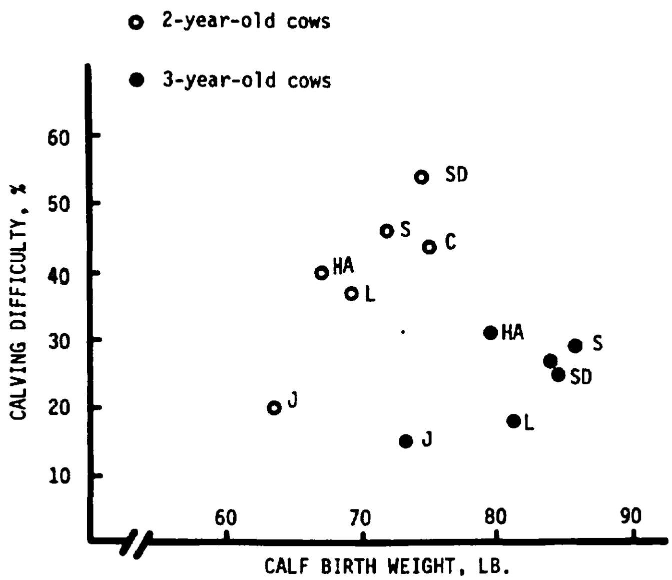

Figure 2. Relationship between calving difficulty and birth weight in calves out of 2-year-old and 3-year-old cows (Smith, Laster and Gregory, 1976).

breed groups such as Chianina and Brahman crosses had less calving difficulty than Maine-Anjou and Charolais crosses due perhaps to shape of calf or possibly other factors not now identified. The results presented in figure 1 are from cows calving at 4 years of age. Results for calving difficulty were pooled on this basis because cows were all 4 years old or older in cycles II and III of the program. The association between calving difficulty and birth weight was greater in 2- and 3-year-old dams in cycle I of the program (figure 2).

Recently studies have been conducted to assess the feasability of altering the shape of the growth curve. Table 6 presents estimates of genetic change that can be expected in yearling weight and birth weight with different levels of index selection for heavier yearling weight (YW) and lighter birth weight (BW). Selection for postnatal gain (ie. YW-BW) will reduce correlated response in birth weight by 14 percent relative to that expected from selection for yearling weight. Selection for heavier yearling weight (YW) but lighter birth weight (BW) with an index = YW-3BW would increase yearling weight about 86 percent and birth weight only 52 percent as much as equally intense selection for yearling weight alone. Similar results were found by Dickerson et al (1974).

More research is needed to determine the most appropriate selection procedure for altering the shape of the growth curve. Apparently, postnatal growth to weaning or yearling ages should be emphasized rather than their respective final weights to eliminate direct selection for heavier birth weight. Although a specific selection index can not be recommended, it does seem appropriate to measure birth weights and to avoid using sires with heavy birth weights.

TABLE 6. EXPECTED CHANGE IN YEARLING WEIGHT AND BIRTH WEIGHT PER STANDARD DEVIATION OF SELECTION FOR DIFFERENT INDEXES.[a]

Index	Expected Change (ΔG)			
	Yearling weight		Birth weight	
	lb	(%)	lb	(%)
YW	30.9	100	2.43	100
YW - BW	29.9	97	2.09	86
YW - 2(BW)	28.5	92	1.70	70
YW - 3(BW)	26.5	86	1.2	52
YW - 4(BW)	24.1	78	.8	32
YW - 5(BW)	23.0	74	.3	12

[a] Offspring midparent heritability of .46 for birth weight, 0.43 for yearling weight and a genetic correlation of .66 (Koch et al., 1974).

Efficiency of Gain

A discussion of feed efficiency should consider the entire life cycle of beef production. Feed used by breeding animals as well as the progeny should be considered. However, there is not time in this presentation to consider feed efficiency on a full life cycle basis. For more thorough discussions of feed efficiency see proceedings of previous Beef Improvement Federation Research Symposia (1971, 1975, 1976 and 1979).

Efficiency of postweaning gain is reported in one national sire evaluation program. The American Hereford Association measures feed efficiency to a weight end point of 1,150 pounds. The choice of end points or interval of evaluation is an important consideration in measuring feed efficiency. Results from the germ plasm evaluation program have shown that ranking of animals or breeding groups can differ depending on whether efficiency is evaluated to age, weight or fat constant end points.

Postweaning (following an adjustment period of about four weeks) feed efficiency for different intervals of evaluation are summarized for steers in figure 3. Feed efficiency (TDN per unit of gain) was evaluated over time constant (0 to 238 days on feed), weight constant (545 to 1,036 lb), and grade constant (0 days to small amount of marbling in the ribeye muscle) intervals. The range between breed groups in feed efficiency was greatest for the weight constant interval. Breed groups with the most rapid growth rates required less feed per unit of gain than slower gaining breed groups because fewer days of maintenance were required in weight constant intervals. The ranking and relative differences of breed groups for feed efficiency in the time constant interval (0 to 238 days postweaning) were similar to that for the weight constant interval, but the range and differences between breed groups were smaller. The larger, faster gaining breed groups were heaviest at weaning and maintained more weight throughout the time constant interval. Even with heavier weights maintained, the faster gaining breed groups were more efficient in the time constant interval.

Feed efficiency from weaning (except for 25 to 30 day adjustment period) to a grade constant end point (0 days to small amount of marbling in the ribeye muscle) is also presented in figure 3. The level of marbling in the ribeye muscle selected as an end point was "small", because this level is the amount required for cattle of these ages to achieve a quality grade of USDA Choice. Breed groups reaching a small level of marbling in the ribeye muscle in the shortest number of days tended to be more efficient.

The Beef Improvement Federation (BIF, 1976), recommends that feed consumption per unit of gain evaluated in time constant intervals (Ti, for ith pen) be adjusted for differences in maintenance requirement by a ratio of test group average metabolic weight ($\overline{W}^{.75}$) to pen average metabolic weight ($W_i^{.75}$) as follows:

$$\text{BIF adj. eff.} = (\overline{W}^{.75} / W_i^{.75})\ T_i$$

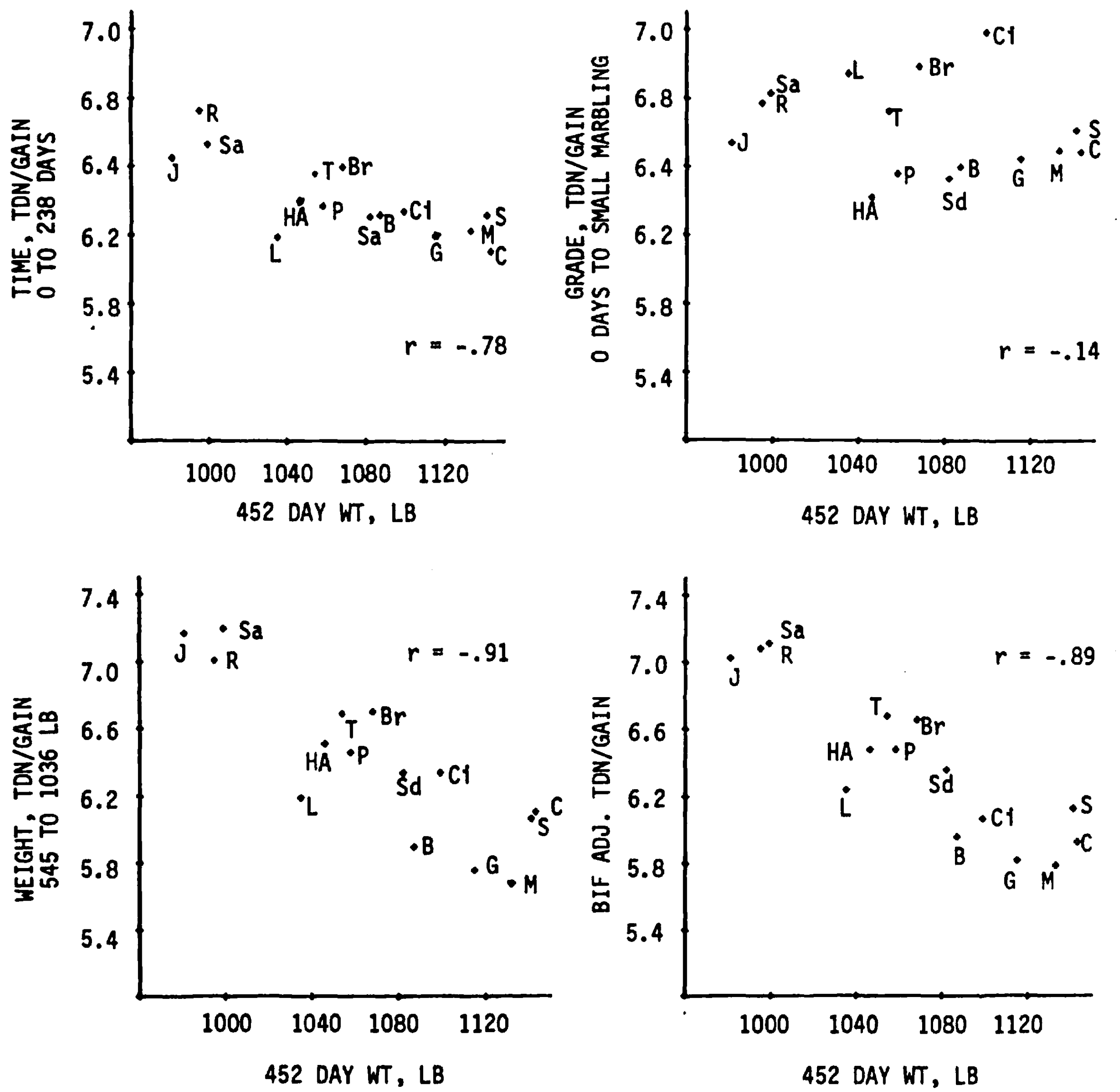

Figure 3. Relationship of 452 day weight to feed efficiency in alternative intervals.

The mid weights used are estimated as ½ (initial weight + final weight). This procedure adjusts feed/gain of heavier than average groups downward, and feed/gain of lighter than average groups upward assuming that maintenance requirements are proportional to weight (in kilograms) raised to the 3/4 power.

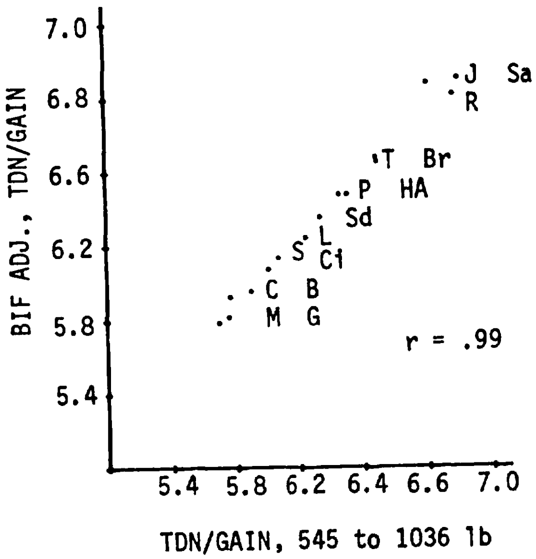

Figure 4. BIF adjusted feed efficiency vs. weight constant TDN feed efficiency.

The breed group means for BIF adjusted feed efficiency are remarkably similar to breed group means for TDN per unit gain in weight constant intervals (figure 4). The correlation between BIF adjusted feed efficiency and weight constant feed efficiency for breed group means was .99. It appears that the procedure recommended by the Beef Improvement Federation yields estimates for feed efficiency that are reasonably close approximations to feed efficiency in weight constant intervals, the evaluation procedure that most favors large fast-growing breed groups.

Evidence from studies of genetic variation within breeds have also indicated a generally favorable relationship between feed efficiency and gain (table 7). The genetic relationship between feed efficiency and gain has been strongest when feed efficiency is evaluated to weight constant end points (Swiger et al., 1965; Dickerson et al. 1974).

TABLE 7. ESTIMATES OF GENETIC CORRELATION FOR MEASURES OF FEED EFFICIENCY WITH GAIN OR FINAL WEIGHT.

Definition of feed efficiency	Gain	Final Weight	Source
Feed/gain	.31		Lindholm and Stonaker (1957)
TDN/gain	-.32		Carter and Kincaid (1959)
Feed/gain	-.41		Lickley *et al.* (1960)
Feed/gain	-.34	.74	Brown and Gifford (1962)
Gain adj. for feed cons.	.79		Koch *et al.* (1963)
Feed, wng. to 1000 lb.	-.94		Swiger *et al.* (1965)
Feed, 400 to 904 lb.	-.64	-.42	Dickerson *et al.* (1974)

Carcass Traits

USDA quality grade (or marbling) and estimated cutability (or USDA yield grade) are included in a majority of national sire evaluation programs. Variation in cutability (percentage of closely trimmed, boneless retail product from the round, loin, rib and chuck) and USDA quality grade are major determiners of carcass value in the current beef trade.

Breed group means for carcass traits of steers in the germ plasm evaluation program are presented in table 8. Carcass and meat data were obtained in cooperation with scientists from Kansas State University in their laboratories. Breed group means presented in table 8 are adjusted to a constant age of 458 days. Breed groups of larger size and more rapid growth rate had less fat trim and lower levels of marbling but greater retail product yield than smaller early maturing breeds when compared at the same age. These relationships were magnified when comparisons were made at the same weight (Koch *et al.* 1976, 1979).

Marbling score is the primary determinant of carcass quality grade. As indicated by table 9, at equal age, breed groups differed significantly in average marbling scores and in percentage of carcasses that had adequate marbling to grade USDA Choice or better. Taste panel evaluation of rib samples from about 1230 animals is summarized in table 9. One of the most significant findings in the carcass and meat trait evaluations was the generally high level of acceptance of meat from all breed groups that came from the same production system but with major differences in size of carcass, fatness and marbling. Cooking preparation was carefully controlled. Taste panel scores did tend to increase as marbling increased when comparisons were at the same age, but the change was slight. While still in the acceptable to moderately desirable range, tenderness scores of the cooked meat were less for the Sahiwal and Brahman crosses than for the breed crosses of European origin. Campion, Crouse and Dikeman (1975) found that marbling accounts for only about 8% of the variation in meat palatability in young cattle fed and managed alike and slaughtered at 14-16 months of age. The rather high degree of acceptance by taste panel evaluation and the low relationship of taste panel scores with marbling score suggest that the production

TABLE 8. BREED GROUP MEANS FOR CARCASS TRAITS ADJUSTED TO A CONSTANT AGE OF 458 DAYS
GERM PLASM EVALUATION PROGRAM, ROMAN L. HRUSKA U.S. MEAT ANIMAL RESEARCH CENTER

Breed group	Number	Shrunk live weight lb.	Carcass weight lb.	Fat thick. in.	Marbling score[a]	Retail product %	Fat trim %	Bone %	Kidney fat %
Jersey-X	134	958	593	.46	13.3	65.5	22.1	12.4	6.2
Hereford-Angus-X	472	1008	637	.64	11.3	66.3	21.7	12.0	3.9
Red Poll-X	106	979	618	.49	11.2	66.6	21.0	12.4	5.1
South Devon-X	94	1031	655	.48	11.3	67.7	20.0	12.3	4.7
Tarentaise-X	102	1010	638	.44	10.1	69.8	17.7	12.5	4.9
Pinzgauer-X	130	1017	629	.46	10.8	69.4	17.5	13.1	4.4
Sahiwal-X	141	962	611	.54	9.7	69.1	18.4	12.4	3.9
Brahman-X	128	1033	663	.56	9.3	69.4	18.0	12.6	4.1
Brown Swiss-X	120	1076	677	.39	10.4	69.1	17.6	13.3	4.0
Gelbvieh-X	108	1090	687	.37	9.7	69.8	17.4	12.8	4.5
Simmental-X	175	1079	673	.39	9.9	71.0	15.6	13.4	4.3
Maine-Anjou-X	109	1103	704	.37	10.2	70.2	16.5	13.3	4.1
Limousin-X	177	1021	652	.41	8.9	72.4	15.1	12.5	4.3
Charolais-X	177	1093	691	.38	10.3	71.8	15.2	13.0	4.2
Chianina-X	112	1077	690	.32	8.5	73.0	13.0	14.0	3.8

[a] Marbling scores: traces = 4, 5, 6; slight = 7, 8, 9; small = 10, 11, 12; modest = 13, 14, 15; . . . .

TABLE 9. BREED GROUP MEANS FOR FACTORS IDENTIFIED WITH MEAT QUALITY
GERM PLASM EVALUATION PROGRAM, ROMAN L. HRUSKA U.S. MEAT ANIMAL RESEARCH CENTER

Breed crosses	Marbling[a]	Percent choice	Warner-Bratzler Shear (lb)	Flavor[a]	Juiciness[a]	Tenderness[a]
Chianina-X	8.3	24	7.9	7.3	7.2	6.9
Limousin-X	9.0	37	7.7	7.4	7.3	6.9
Brahman-X	9.3	40	8.4	7.2	6.9	6.5
Gelbvieh-X	9.6	43	7.8	7.4	7.2	6.9
Sahiwal-X	9.7	44	9.1	7.1	7.0	5.8
Simmental-X	9.9	60	7.8	7.3	7.3	6.8
Maine-Anjou-X	10.1	54	7.5	7.3	7.2	7.1
Tarentaise-X	10.2	60	8.1	7.3	7.0	6.7
Charolais-X	10.3	63	7.2	7.4	7.3	7.3
Brown Swiss-X	10.4	61	7.7	7.4	7.2	7.2
Pinzgauer-X	10.8	60	7.4	7.4	7.2	7.1
South Devon-X	11.3	76	6.8	7.3	7.4	7.4
Hereford-Angus-X	11.3	72	7.3	7.3	7.3	7.3
Red Poll-X	11.5	68	7.4	7.4	7.1	7.3
Jersey-X	13.2	85	6.8	7.5	7.5	7.4

[a] Marbling: 5 = traces, 8 = slight, 11 = small, 14 = modest, 17 = moderate.
TP scores: 2 = undesirable, 5 = acceptable, 7 = moderately desirable,
9 = extremely desirable.

system and cooking preparation will likely be the most effective means of improving eating satisfaction rather than through breeding.

Breed groups which had the highest marbling scores also had the lowest percentage of retail product (tables 8 and 9) indicating a strong negative relationship between marbling and percentage retail product. Also, breed groups which had the highest marbling scores had the highest percentage of fat trim. Similar relationships have been found within breeds (table 10).

Estimates of the genetic correlation between marbling and retail product percentage have generally been strongly negative, indicating that selection for one trait will reduce the other or that simultaneous selection for increased retail product yield and increased marbling would be ineffective. Furthermore, estimates of the genetic correlations between marbling and fat trim percentage have been strongly positive indicating only limited opportunity to increase carcass quality grade without increasing fat trim.

TABLE 10. GENETIC CORRELATIONS FOR USDA QUALITY GRADE (OR MARBLING) WITH RETAIL PRODUCT AND FAT TRIM

Source	Retail product	Fat	Definition of traits
Shelby _et al_. (1963)		.23	Qual. grade, fat thickness
Cundiff _et al_. (1964)	-.80	1.00	Qual. grade, est. cutability, fat thickness
Swiger _et al_. (1965)	-.85	.56	Qual. grade, act. % retail prod., fat thickness
Brackelsberg _et al_. (1971)		.23	Qual. grade, % fat trim
Cundiff _et al_. (1971)	-.89	.98	Marbling, act. retail prod. and fat trim (constant weight)
Dinkel and Busch (1973)	-.38	.37	Marbling (const. age & wt), % edible portion, % fat trim (constant weight)

Conclusions

Weight at birth, weaning, yearling and mature age are highly heritable and strongly correlated. Birth weight is strongly associated with gestation length, calving difficulty and perinatal mortality. It is important to measure birth weight. Use of sires with excessive birth weights should be avoided.

Cattle of largest size require less feed per unit of gain in time and weight constant postweaning intervals. Feed efficiency to a quality grade or marbling end point is not strongly correlated with growth rate or size. Earlier maturing cattle that reach marbling end points in the shortest period of time are most efficient to marbling end points. Genetic variation is greatest when postweaning feed efficiency is evaluated on a weight constant basis. BIF adjusted feed efficiency is highly correlated with feed efficiency in weight constant intervals.

Carcass cutability is highly heritable and strongly associated with size. Carcass cutability is negatively associated with marbling. Marbling and percentage fat trim share a high positive association. There is very little opportunity to increase cutability without reducing marbling. Differences between breed groups in palatability of meat have been small in young cattle fed and managed uniformly consistent with current commercial production practices and slaughtered at 14-16 months of age, regardless of marbling level.

Because there are genetic antagonisms among calving, growth, and carcass traits, it is not possible for any one breed to excell in all characteristics of economic importance. Nor is it possible to expect simultaneous improvement in all characteristics from selection within breeds. Selection objectives for the breed, or populations within the breed, should depend on the breeding system employed in the commercial herds being provided with seed stock (table 11).

General purpose breeds are needed if the commercial production systems served are straightbreeding or following rotational crossbreeding systems (figure 5). Rotational crossbreeding systems provide for use of substantial benefits of heterosis.

Pounds of beef produced per unit of feed consumed by cows and calves can be maximized by combining rotational crossing with terminal sire crossing. Rotational-terminal sire systems (figure 6) should involve rotational crossing of maternal breeds of small to medium size chosen to synchronize maternal performance with feed and other production resources available. The terminal sire breed producing crossbred progeny, all of which are marketed for slaughter, should excell in rate and efficiency of growth and transmit superior carcass cutability. Rotational matings of maternal breeds providing for female replacements should involve the younger half of the cows in the herd. Terminal crosses should only be made with cows of mature ages to avoid calving difficulty.

TABLE 11. SELECTION EMPHASIS[a]

	Population		
	General Purpose	Maternal	Paternal (Terminal sire)
Reproduction	++	+++	+
Growth			
Birth weight	—	—	0
Weaning weight	+	++	++
Yearling weight	+	0	+++
Mature size	0	0	+
Carcass			
Cutability	0 or +	0	++
Marbling	0 or +	++	0

[a] Some emphasis in negative direction (—), and no (0), some (+), strong (++) and very strong (+++) emphasis in positive direction.

A strong case for more rapid and efficient growth rate as a selection objective, can only be made for terminal sire populations. Some restriction should probably be placed on birth weight, even in terminal sire breeds to prevent increases in calving difficulty. Correlated response in mature weight can be tolerated in terminal sire breeds, but direct selection for mature size does not seem indicated.

In maternal breeds, reproduction traits should receive major emphasis. Calving ease, lighter birth weight and heavier weaning weight from a maternal point of view should be emphasized.

It is more difficult to decide on selection objectives for general purpose populations because of the major genetic antagonisms among calving, growth and carcass traits. It seems appropriate to stress reproduction more than any other trait. Assuming that the population is competitive in growth rate, weaning and yearling weight should only receive limited emphasis to avoid associated increases in birth weight and mature size.

In view of the strong negative genetic correlation between cutability and marbling, only minimal or no emphasis should be placed on these traits in general purpose populations. However, cutability should be emphasized in terminal sire breeds and marbling can be emphasized in

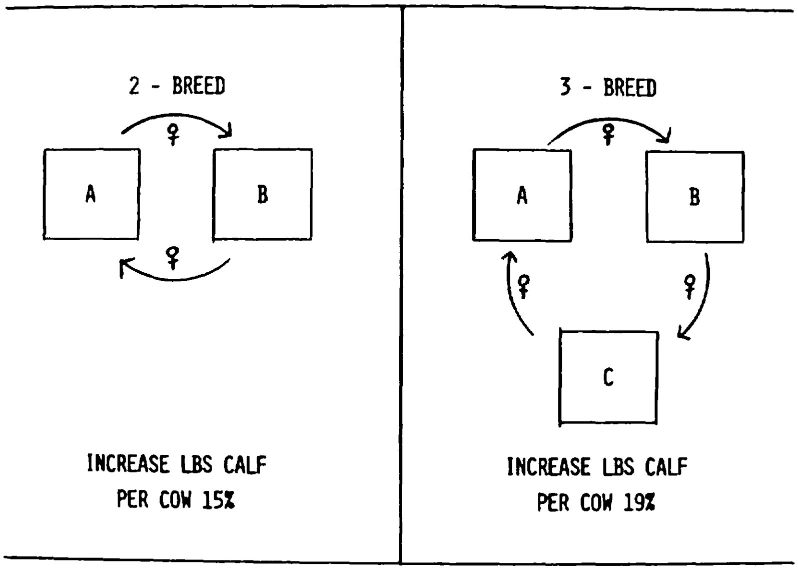

Figure 5. Rotational systems of crossbreeding.

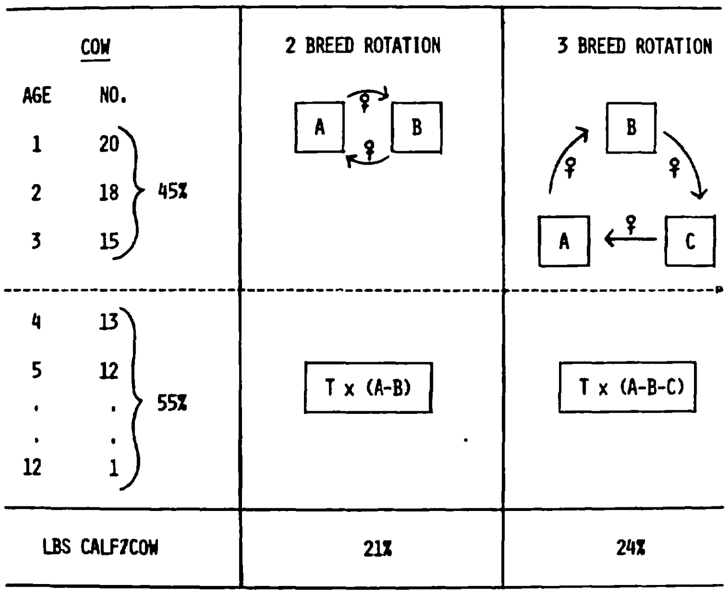

Figure 6. Rotational-terminal sire crossbreeding systems.

maternal breeds because the strong negative genetic correlation does not prevent improvement in both traits in terminal crosses produced in commercial production.

Even though selection objectives should not emphasize all traits in all populations, it does seem appropriate to measure and monitor all traits to the extent it is economical as a precaution against extremes and adverse responses that can result from chance and other unforeseen hazards.

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SIRE EVALUATION FOR REPRODUCTIVE TRAITS[1]

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Reproductive performance represents the greatest economic important production traits in the cow-calf industry. It is generally thought of as single expressed trait (presence or absence of a calf at weaning time) but in reality it is many traits, all of which are largely influenced by environment. What we commonly measure as reproductive success (weaned calf) is the end product of a series of events whereas the end product can be no greater than the weakest link in that series of events. (Table 1).

Reproductive performance of a herd consists of both a male and female component plus the post-conception period. Generally speaking, the male component deals with the production of fertile gametes and physically delivering those gametes during the mating act. Several of the components of male fertility are under genetic control but environment plays a very large role.

In recent years, size of testicles has been shown to be positively correlated with sperm production. Some Colorado research has also shown a positive correlation between size of testicles and sexual maturity in heifer cattle. Size of testicles is easily measured, both objectively and subjectively and thus breeders are likely to accept this measurement as worthwhile.

Other measurements which could be taken in the male which are heritable to some degree and are related to fertility are those traits associated with semen quality. These traits are not easy to measure, require expensive equipment and special training for interpretation. Even with these sacrifices, they have not been highly accurate predictors of fertility levels. They can identify the grossly inadequate bulls and eliminate those from service. Some early Colorado data suggests that 15-16% of all yearling bulls have questionable semen quality. Thus, semen evaluation is a management tool for screening breeding bulls but it probably has limited value as a selection tool.

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[1] Invited paper presented at Beef Improvement Federation Annual Meeting, Denver, Colorado, on April 29, 1980

Bulls also have to be capable of completing the mating act. This requires physical ability in both the reproductive and skeleton systems. It also requires a mental ability or libido. The physical aspects of the delivery system are highly heritable. Skeletal problems such as post-leg, small frame, etc., are easily corrected through selection. Reproductive tract soundness traits, such as cryporchid, also are heritable. Although, there is some learning required by the bull in completion of the mating act, the hormonal system, which is probably under some degree of genetic control, seems to be the important factor in libido. It is not easy to measure with present knowledge and skills.

There are a great deal of environmental factors which have a large influence on bull fertility. These would include such things as technician skills in an artificial insemination program, topography of pastures, nutrition, stress, disease, etc. These are management traits which producers must be aware exists.

Although it may appear to many of you that we do not know a whole lot about the genetic component of bull fertility, we probably know even less about the female. It is safe to say that most animal husbandrymen believe there is a genetic component to fertility, but an accurate appraisal of exactly how large that genetic influence really is, escapes us.

As was stated with the bull, reproductive tract and structural soundness traits are heritable and can be minimized through selection. Ova production is somewhat a mystery. Research has taught us that heifers are born with all of the primary oocytes their ovaries will ever bear. This is in contrast to the bull where spermatogensis is an on-going process following puberty. There is evidence that age and weight at sexual maturity are genetically controlled because of family and breed differences. Weight probably is the most important factor. Puberty is a trait which is measurable by the laymen, but the other traits such as oocyte production, fertilizing ability, cleavage, etc., are not measurable and, therefore, do not lend themselves to selection pressure.

The environmental factors such as nutrition, disease, stress and technician also exert large influences upon the cow.

Once the sperm and egg unite to form an zygote and develops into an embryo, still more genetic and environmental forces influence subsequent reproductive performance of a herd.

Survival of the embryo in utero and ability of the cow to nourish the embryo are influenced both genetically and environmentally. Current techniques do not allow us to measure the genetic aspect other than she was pregnant and now she is not. Separation from the environmental part is extremely difficult.

Calving ease is again genetic and environmental but it is a trait that can be measured with some degree of success. Mothering ability is more subjectively than objectively measured but it is possible to measure this trait. Mothering ability is defined in this case as claiming the calf, cleaning the calf, staying with it, being protective. Milking ability, after first milk, falls into a production trait rather than reproductive category.

In table 3, all of the reproductive traits are listed and categorized as more genetic than environment influences, vice versa or about even. Take notice that some traits are not placed into any category and that is because it is questionable where they should go.

In general, it appears that there are several reproductive traits which are measurable and should be included in a within herd records program. These are:

1. Testicular size
2. Success rate in impregnating cows in a given period of time (natural mating).
3. Number of pregnancies per services with artificial insemination
4. Reproductive trait soundness
5. Weight and age at puberty
6. Calving ease
7. Mating capacity in bulls
8. Calf liveability

An underlining question is, can we effectively select for reproductive performance? It is recognized that the calculated heritability of reproductive performance is low; however it is in the positive direction and realized heritability may be greater than calculated because we can go backwards very easily. This suggests that even though it is difficult to measure and at best response will be slow, monitoring successful reproduction is one of the most important things records program can do.

The basic principle in selection is:

Phenotype = Geneotype + Environment + G+E interaction.

All traits have some genetic component to it, even though it may be very small or quite large. As the environmental component becomes larger, the more difficult it becomes to accurately recognize the genetic differences existing between individuals.

Selecting for reproductive performance will be difficult and slow. Breeders will not see much results to their efforts. However, it is probably the most important things we can offer in sire evaluation programs and if we are even capable of retaining current levels of reproductive performance as determined by number of calves weaned per 100 cows exposed to service, our efforts will be successful.

Table 1. Illustration of accumulative effects upon reproductive performance of a cow herd.

Bull fertility	x	Cow fertility	x	Post-conception survival	=	Net calf crop
1		1		1	=	100%
0		1		1	=	0%
.9		.9		.9	=	73%

Table 2. Illustration of factors which can alter fertility level and influence reproductive performance of the herd.

Bull fertility x	Cow fertility x	Post-conception survival	= Net calf crop
Sperm production	Ova production	Embryo survival	
Size of testicles	Ovulation		
Number of sperm	Normality	Utero-mothering	
Quality	Fertilizing capability		
Fertilizing capability	Cleavage	Calving ease	
Sexual maturity	Sexual maturity		
Delivery and/or Function	Delivery and/or Function	Calf liveability	
Libido	Estrus		
Reproductive tract soundness	Reproductive tract soundness	Mothering ability	
Structural soundness	Structural soundness	Nutrition	
		Disease	
Environment	Environment	Stress	
Nutrition	Nutrition		
Disease	Disease		
Stress	Stress		
Topography	Technician		
Cow/bull ratio	Milking ability		
Technician			

Table 3. The relative importance of genetic and environmental influence of traits

		G>E	G≈E	G<E
Sperm production:	Size of testicles	X		
	Number of sperm	X		
	Quality		X	
	Fertilizing capability		X	
	Sexual maturity			X
Delivery and/or function:	Libido		X	
	Reprod. tract sound	X		
	Structural sound.	X		
Environment:	Nutrition			X
	Disease			X
	Stress			X
	Topography			X
	Cow/bull ratio			X
	Technician			X
Ova production:	Ovulation			
	Normality			
	Fertilizing capability			
	Cleavage			
	Sexual maturity			X
Delivery and/or function:	Estrus			X
	Reprod. tract sound.	X		
	Structural sound.	X		
Environment:	Nutrition			X
	Disease			X
	Stress			X
	Technican			X
	Milking ability		X	
Embryo survival			X	
Utero-mothering			X	
Calving ease			X	
Calf liveability			X	
Mothering ability			X	
Nutrition				X
Disease				X
Stress				X

IMPACT OF SIRE EVALUATION ON DAIRY CATTLE BREEDING[1]

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INTRODUCTION

Dairy cattle breeding has made major advances in recent years. The industry is rather well organized to make genetic progress, though many improvements are yet to be made. Production and demand for milk and milk products have been nearly balanced in recent years. Consumption has changed from less whole milk to more 2% milk and cheese consumption has increased sharply. Cow numbers have decreased and herd size increased with greater production per cow. This change in structure of the industry and the relatively favorable economic position of dairymen in the last few years have enabled them to pay for continued genetic improvement. These changes, together with much improved sire and cow evaluation, with more intense sire selection, and with intense competition between artificial breeding organizations has led to an increasing acceleration in the rate of genetic change for economic characters in dairy cattle. The object of the remainder of this discussion will be to characterize some aspects of the industry as they relate to genetic improvement, how they act in a synergistic manner, and the genetic improvement that has been accomplished.

ATTRIBUTES THAT MAKE GENETIC IMPROVEMENT FEASIBLE

Milk sales from the cow makes her the primary production unit as contrasted to the calf being the primary saleable product in a beef context. So, genetic improvement is recoverable directly through several lactations without additional genetic segregation which results when each new calf is produced.

Milk production, including its components, is easily and accurately measured on a cow basis within and across herds. Dairy cows have a rather large unit value which together with favorable net returns justifies intensive management. Dairy cows respond to improved management, which is well documented in many nutritional trials. This, in turn, justifies increased genetic inputs to management.

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[1]Invited paper presented at the Beef Improvement Federation Symposium and Annual Meeting, Denver, Colorado, April 30, 1980.

The relatively large unit value per cow is not entirely an asset. Involuntary losses are expensive and rearing of replacements has a major influence on net returns (Pearson and Freeman, 1973). Replacement rates of cows are much higher in dairy herds than beef herds. Normal replacement rates are about 25% per year. Replacement rates are about 35% in well managed herds of constant size with few calf losses where all heifers are freshened. Since many losses are involuntary, cow culling accounts for only about 6% of the genetic progress in milk production in populations of moderate size (Rendel and Robertson, 1950).

Management of dairy cattle requires confinement of cows for milking. Management systems differ in the amount of attention given to individual cows; however, all management systems are conducive to frequent and easy cow handling compared to beef cattle. Such management is also conducive to easy and successful use of artificial insemination (AI). A similar analogy seems correct in beef cattle. Cows reared under intensive management can be bred artificially easier than under more extensive management, given both systems can afford to inseminate artificially.

POPULATION ATTRIBUTES RELATIVE TO GENETIC IMPROVEMENT

Dairy cattle breeds have remained distinct over time and there is little reason to think they will not remain so. All breeds compete in a market where, in general, even though there is a differential price paid for butterfat percentage the primary emphasis has been on volume of milk. The dairy breeds have competed with different degrees of success. The Holstein breed has increased in numbers over time at the expense of other breeds. The result is the Holstein breed is now dominant. Holsteins now comprise about 85% of the commercial population. Further, breeders of Holsteins have the opportunity to improve genetically at a faster rate than the other breeds because the larger number of cattle enable faster improvement, both genetically and economically.

All sires used in AI have been from the registered segment of each breed, despite the large segments of nonregistered cattle, particularly in Holsteins. Less than 10% of all Holsteins are registered. How long this will continue is now known, but clearly the registered segment of the population will continue to be under increasing pressure by the nonregistered segments of the population, again particularly in Holsteins. A relatively large portion of the nonregistered cows produce as much or more than registered cows.

Crossbreeding has had no impact in dairy cattle, except for a fraction of the colored breeds being continuously mated to Holsteins, or "graded-up" to Holsteins. Experiments comparing breeds (McDowell and McDaniel, 1968; Touchberry, 1978) have shown little heterosis for production tratis. The general conclusion is that there is little or no useful heterosis for production. Only occasionally has a breed cross exceeded the Holstein in milk or butterfat production. There is evidence for real heterosis in calf liveability (Touchberry, 1978), but this has not been enough advantage to stimulate crossbreeding in dairy cattle.

The importance of crossbreeding in beef cattle is obviously very different than in dairy cattle. Maintenance of distinct breeds in large enough numbers to be genetic resources in crossbreeding beef cattle is highly important to the industry. Even with crossbreeding, continued progress is needed through selection within breeds. Whether selection goals should be the same or different for the beef breeds depends upon the breeding structure of the commerical population in beef cattle. Selection goals have been rather uniform in dairy breeds.

ORGANIZATION OF DAIRY CATTLE POPULATIONS TO ACCOMPLISH GENETIC IMPROVEMENT

The synergistic actions of Dairy Herd Improvement Programs (DHI), AI, sire and cow evaluation, and research--all of which rely on computers--all combine to produce genetic improvement in economically important traits. People, including breed associations, must cooperate to allow and encourage the synergistic affects of these parts of the industry. Let's consider these individually.

Dairy Herd Improvement Programs

Accurate recording of performance is essential for efficiency genetic improvement. The measurement of performance should be consistent from herd to herd over time. DHI provides such measurement of performance. Further, a reasonable proportion, 36.8%, of the cow population is enrolled in official testing programs (King and Myers, 1979). The portion of these records that are identified by sire and pass computer screening for errors are used for sire and cow evaluation.

The basic purpose of DHI is to provide records for within herd management. This has been and still is the reason dairymen pay for the service. These records provide many management aids in addition to individual cow production. Feeding recommendations, reproductive records, lists of cows to turn dry, to breed, culling recommendations and many summary records are provided in various forms from different processing centers. The measurement and recording of production is, however, standardized over the nation. DHI records are the cornerstone for commercial breeding.

Sire and Cow Evaluation

Estimating breeding values or transmitting abilities of sires and cows started after 1900 in dairy cattle breeding and has a major influence on genetic improvement. The methods of estimating breeding values have changed frequently over time.

Rendel and Robertson (1950) estimated that genetic progress resulted from four paths of improvement in the following percentages: Sires to breed sires (43%), dams to breed sires (33%), sires to breed cows (18%), and cows to breed cows (6%). While this is an approximation and will change with population size, methods of selection and other variables, it indicates the tremendous importance of sire selection. Seventy-six percent of the progress is made by how sires are bred, and an additional 18% from the choice of sires to breed cows. The contribution of sire evaluation to allow correct choice of sires and cow evaluation to enable choosing the best cows as dams of sires is clearly evident from this example.

A short review of the history of sire evaluation and its evolution relative to genetic change will be considered. Bereskin (1963) reviewed the history of dairy sire evaluation. Simple daughter averages without any other consideration, either genetic or environmental, were the first sire evaluations. In 1913, Hansson in Sweden published the equal parent index which was a predecessor of daughter-dam comparisons. Daughter-dam comparisons are biased by time trends, either genetic or environmental, because daughters always produce later in time than their dams. Also in 1913, Peters in Germany suggested comparing daughters to herdmates. This suggestion did not result in widespread use. Modifications of the equal parent index and daughter-dam comparisons were suggested in the 1920's and 1930's. The daughter-dam comparison was used by USDA on national basis until 1962. This is no real evidence of the effectiveness of the sire evaluation method nationally or what the national rate of improvement was during these years, although some improvement probably was made. In 1954, C. R. Henderson reported the herdmate comparison was more accurate in evaluating sires than daughter-dam comparisons and he suggested adjusting the herdmate comparison for number of daughters. These procedures were used by Cornell University to rank bulls used in New York. Herdmate comparisons were used on a large scale in 1950 in New Zealand and in Great Britain in 1954. Searle (1964) discusses these procedures. USDA published the herdmate comparisons from 1962 until 1974 when it was replaced with the USDA-DHIA Modified Contemporary Comparison (MCC) (Dickinson et al., 1976). C. R. Henderson (1966) proposed a "direct" comparison procedure which has Best Linear Unbiased Prediction (BLUP) properties. This has been used to rank bulls in the Northeast United States. Henderson published a series of papers which extended the methods of sire and cow evaluation. These methods (Henderson, 1975a,b) allowed the practical application of an inverse relationship matrix to use relative information simultaneously with progeny performance to estimate breeding values. Sires and maternal grandsires of the bull being evaluated were considered first. Later he extended methodology to use all relatives within herds, plus AI sires and maternal grandsires to rank cows. In general, methods of cow evaluation developed parallel with sire evaluation but mostly with some lag in time. The same general types of procedures have been used.

In Iowa, cows have been evaluated using the cow's record, plus records of her daughter, dam and paternal and maternal half sibs since 1968. This cow evaluation procedure has been shown to be effective in predicting daughter performance (McGilliard and Freeman, 1976), and effectively uses genetic differences between herds (Spike and Freeman, 1978) by giving the cows proper credit for the genetic differences from the herds in which they were bred.

The greatest advances in sire evaluation have been since the early 1950's. This resulted from having access to DHI data where sires were used across herds. The geneotypes of sires, in paternal half sib groups, were measured across many different environments or herds. Also, advances in computer hardware enabled handling these records.

Herdmate comparisons enabled significant genetic advances to be made. Actually, herdmate comparisons enabled distinguishing differences between sires so that effective selection could be practiced. The assumptions underlying use of herdmate comparisons for sire evaluation are that sires are selected at random from a common population of sires, that these sires' progeny are compared against random herdmates, all drawn from a single static population within breeds, that there was no selection of daughters or herdmates, that no preferential treatment was given to progeny groups, and that there was no genetic trend in the population. Also, mating was assumed random.

Substantial genetic gain was made from the late 50's through the 60's, and still continues. This gain was made using herdmate comparisons and progressively made the assumptions underlying the use of herdmate comparisons less valid. Thus, herdmate comparisons became progressively less useful. Young sires' daughters were compared against daughters of more highly selected sires. The results were that progeny tests of older bulls declined over time and progeny tests of young bulls were substantially biased.

Sire evaluation procedures were changed in 1966 in the Northeast U.S., computed by Cornell University, and all over the U.S. in 1974, computed by the USDA Animal Improvement Programs Laboratory. Cornell uses methods with BLUP properties and in 1980 introduced the daughters' maternal grandsire into the model (Everett et al., 1979). Cornell also changed the base to which all sire and cow evaluations were expressed to 1980. USDA uses the Modified Contemporary Comparison and expresses all sire and cow evaluations to a 1974 base. Both adjust for genetic trends and all animals can be compared fairly regardless of their age. Thus, sires and cows can be selected by differences in their point estimates of breeding value without these other considerations. These evaluation techniques allow the most accurate and timely evaluations of breeding stock ever available to dairymen.

The beef industry has and is using the ratio of various measures of performance. The base of comparison is simply the animals represented in the particular performance test. Further, ratios and herdmate methods are used in some sire evaluations. Herdmate comparisons using ratios are subject to the same assumptions as herdmate comparisons using deviations and will become progressively less useful as these assumptions are violated and genetic progress is being made in the respective populations.

Artificial Insemination

Sire used in artificial insemination control the genetic destiny of dairy cattle in the United States. About 65% of all dairy cattle are artificially bred and some artificial insemination is used in about 80 percent of the herds (personal communication, G. A. Doak, Service Director, National Association of Animal Breeders, 1980). These are estimates because exact statistics are not available. An additional but unknown part of the bulls used to breed naturally the remaining cows are first generation progeny of AI sires.

The selection of young bulls to be progeny tested and which progeny tested bulls are selected for extensive use is controlled by the genetic personnel in about 13 studs. The goals and direction of selection programs is, however, directly influenced by members of cooperatives elected to sire advisory committees or committees with direct sire selection responsibilities. Acceptance by commercial dairymen utlimately sets the goals of selection for all artificial breeding organizations.

Artificial inseminations allow extensive use of sires--both good and bad. Sires in active AI use probably average 20 to 35 thousand services per year and an occasional bull may make a hundred thousand or more services per year. Obviously, the breeding worth of bulls must be known with reasonably accuracy before they are used so extensively.

Selection procedures are rather well defined to obtain sires for use in AI. The vast majority of sires are produced by contract matings between studs and breeders. All registered cows are screened using their estimated transmitting abilities for milk, fat, and fat percentage. The identy of about the top 2% of these highly selected cows in each breed are made available to anyone interested. Studs screen these cows for conformation traits and for other potential problems. The cows eventually selected as bull dams are mated with a sire mutually agreeable to the breeder and stud and they·agree on a price for male calves. These male calves are then progeny tested in the commercial population and the best selected for active AI use. The sires used to produce these young bulls can be more accurately selected than dams because all are progeny tested and most are high repeatability bulls. A relatively small number of sires are used as mating sires. Across all studs in Holsteins perhaps 50-60 bulls are used per year, but among these the best are used the most extensively. In recent years, breeders have formed syndicates to obtain multiple-herd progeny tests on sires selected by the breeders. The best of these sires are put into active AI service, usually with a semen royalty going to the syndicate.

Studs use different progeny testing procedures and different incentives to encourage use of young bulls. All attempt to get random use of young sires and appear to be successful.

Research and Computers

The sires that are now routinely available to dairymen result from the use of highly specialized technology, both genetic and physiological. This level of technology results from years of research. The genetic developments would not have been possible without sires being used across herds and are depended upon developments in statistics, computer hardware, DHI, other measures of performance.

Sire and cow evaluation procedures are only part of the genetic developments used to produce genetic gain. Modeling alternative ways to structure selection showed that young sire selection and evaluation procedures keeping bulls alive until progeny tested were near optimum for production traits in larger population sizes, but are not optimum for all populations. Management traits or traits that have lower heritabilities may require other methods of data collection and introduce other considerations. An example is dystocia, considered as a trait of the sire. All Holstein sires in studs are currently evaluated for the ease of birth of their progeny (Berger and Freeman, 1977). This is organized by the National Association of Animal Breeders (NAAB) whose member studs work with dairymen to collect the original data and arrange, at NAAB expense, to get the analyses conducted.

As the industry makes progress, research is needed to monitor the effectiveness of selection and suggest methods to correct any deficiencies. When there is need to change selection goals or improve the effectiveness of selection, new methods are needed. To meet these developing needs almost surely will require cooperative effort of research personnel at universities and USDA with the industry, in addition to research personnel employed directly by the industry. The dairy industry is now both cooperating actively in research and supply limited funds to universities for research.

GENETIC IMPROVEMENT

The genetic gain in milk and fat production has been real in recent years, but it is not possible to document exact values for the nation over a long period of time. Powell and Freeman (1974) reviewed the literature on genetic trends. Using data published from 1961 to 1974 the estimated genetic trends averaged 102 pounds of milk and 3.3 pounds of fat per year. Within this time period there was an indication of the trend increasing with time; however, the estimates were from different subpopulations of Holsteins and may not represent total national trends. An estimate of genetic trend on a national basis before 1974 is not available.

Since 1974 when USDA started computing estimated transmitting abilities holding the base for sire evaluation constant, trends in sires Predicted Differences (PD's) give an estimate of genetic change due only to sire selection. Sires are classified as active AI sires, meaning those that have semen available through AI studs. This is almost entirely progeny tested sires. The classification of AI sires has changed slightly, but this is still the best available data to assess genetic change on a national basis. The other classification is non-AI sires. The change in Predicted Difference milk (Figure 1) has been from +368 in 1974 to +977 in January 1980, a change of 609 pounds or about 101 pounds per year due to sire selection alone. Exact data on non-AI sires was not readily available for 1974, but an estimate of the average Predicted Difference of non-AI sires is -204 pounds. In 1980, the non-AI average was +50 pounds. This increase is 254 pounds or 42 pounds per year. The non-AI sires are not only below the active AI sires, but their rate of increase is less than the active AI sires. In January 1980, the difference is +977 pounds for active AI sires and +50 pounds for AI sires. Clearly, sires available in AI are superior to non-AI sires and becoming more superior. In 1974, a +1000 PD milk sire was generally thought to be exceptional. Now, +977 is the average of all active AI sires and the highest bull evaluated in January 1980 was +2329 PD milk.

Changes in the average of all active AI sires from the fall of 1977 to the winter of 1980 are given in Tables 1, 2 and 3 for PD milk, PD fat and PD % fat, by breeds. The change can be interpreted properly only within breeds, because the 1974 base is different for each breed. For milk and fat the active AI sires available to dairymen have increased for all breeds except Ayrshire. The increase has been greatest for Holsteins in both milk and fat. All breeds except Jersey have increased in % fat but by only .01 or .02%. Jersey selection has purposely been directed for milk more than fat, resulting in a decrease of -.04 in % fat of active AI sires from the fall of 1977 to January 1980. Since the genetic correlation between milk yield and fat % is negative and since much selection has been for milk it is slightly surprising that the % fat of active AI sires has not decreased. For Holsteins, the change in the average of active sires for PD milk has been about 130 pounds for milk per year from the fall of 1977 to the winter of 1980. Genetic gain has been greatest in Holsteins. Selection could be greater in Holsteins because of the larger population size and because greater selection could be economically justified.

EXPECTATIONS FOR THE FUTURE

One might ask what can be expected in the immediate future? Trends in selection practiced in Holsteins will be reported at the 1980 annaul meeting of the American Dairy Science Association by Lee, Philipsson and Freeman. Average PD's for milk, fat and fat percent of sires of sons changed from +1001 pounds, +30.8 pounds, and -.036% for sires of sons born in 1973 to +1355 pounds, 39.4 pounds, and -.063% for 1977. Corresponding values for maternal grandsires were +590 pounds, 17.6 pounds, and -.024% for 1973 vs. +1038 pounds, 33.2 pounds, and -.029% for 1977. Pedigree selection has increased materially for milk and fat and decreased slightly for % fat from sires born in 1973 to 1977. Selection on maternal grandsires has been particularly strong. Applying a selection differential after progeny testing of one PD standard deviation, which is the present average selection differential, gives an expected mean for active AI sires in 1983 of about 1188 pounds of milk and 39.6 pounds of fat.

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Table 1. Change in PD milk-active AI sires - USDA

	Fall 1977	Winter 1979	Summer 1979	Winter 1980
Ayrshire	595	534	570	568
Guernsey	552	703	749	727
Holstein	652	880	928	977
Jersey	735	859	982	985
Brown Swiss	680	788	782	803
M. Shorthorn	841	865	794	903
All Breeds	656	857	908	950

Table 2. Change in PD fat-active AI sires - USDA

	Fall 1979	Winter 1979	Summer 1979	Winter 1980
Ayrshire	19	19	20	19
Guernsey	19	27	28	28
Holstein	14	21	24	27
Jersey	25	28	33	33
Brown Swiss	23	25	25	25
M. Shorthorn	30	34	31	35
All Breeds	16	22	25	27

Table 3. Change in PD % fat-active AI sires - USDA

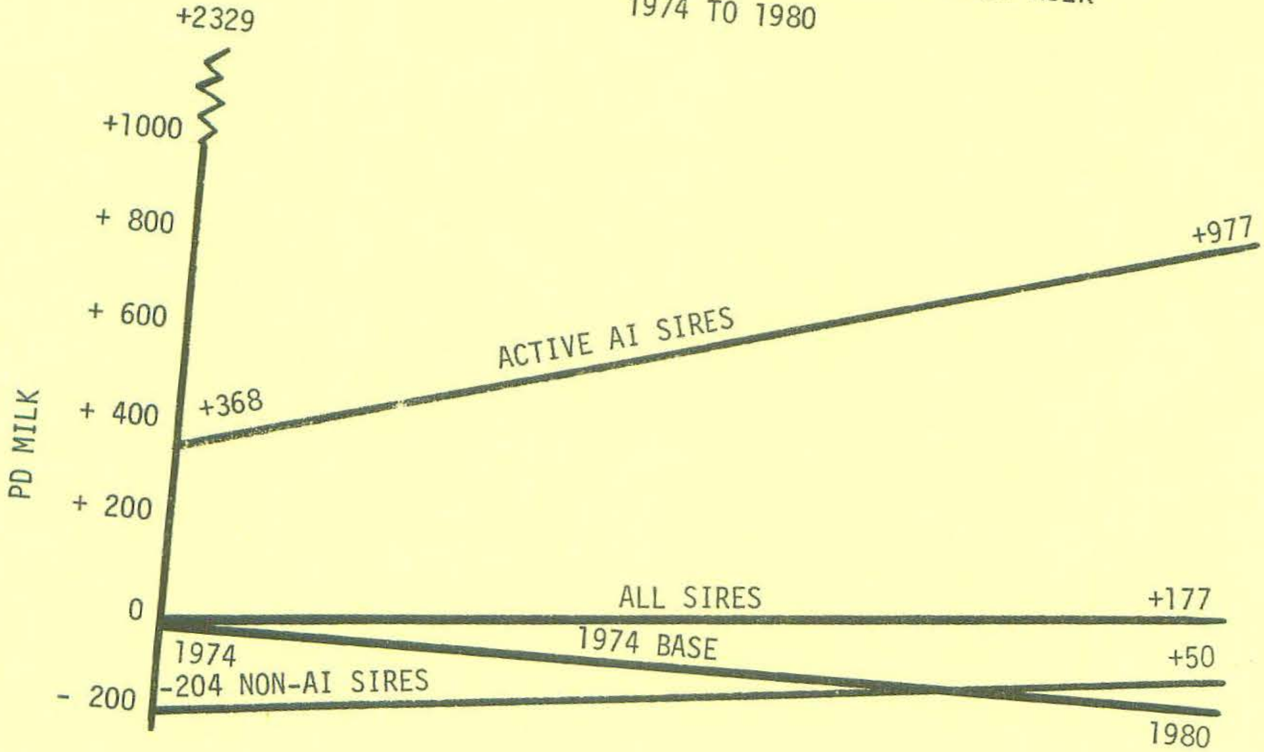
	Fall 1977	Winter 1979	Summer 1979	Winter 1980
Ayrshire	-.04	-.02	-.02	-.03
Guernsey	-.07	-.06	-.07	-.06
Holstein	-.07	-.07	-.06	-.06
Jersey	-.13	-.16	-.17	-.17
Brown Swiss	-.04	-.05	-.05	-.06
M. Shorthorn	-.01	+.02	+.02	+.02
All Breeds	-.07	-.06	-.05	-.05

Table 4. Distribution of bulls, PDM, active AI, winter 1980

Range	Ayr	Guer	Hol	Jer	Swiss	Milking Shorthorn
2000 and up			6		1	
1800-1999			6	3		
1600-1799			27	1		
1400-1599		2	61	9	2	3
1200-1399		1	112	10	5	
1000-1199	2	6	146	17	5	1
Total	16	39	725	89	45	12

Figure 1.

CHANGE IN HOLSTEIN PREDICTED DIFFERENCE MILK
1974 TO 1980



UTILIZING SIRE EVALUATION DATA[1]

Roy A. Wallace
Chairman, Beef Programs
Select Sires, Inc.

I have approached this subject from the standpoint that utilizing sire evaluation data is relatively simple. You use the good bulls and discard the others, because there are no other reasons to test bulls if we do not discard the ones that are not genetically superior and utilize to the utmost the bulls that are superior in the economically important traits.

I learned a long time ago that, no matter how genetically superior a bull is, unless the semen from the bull entered the uterus of a cow and fertilized an egg, no genetic improvement could be made. I have learned from many years in the A.I. business that semen setting in our storage tanks will not increase the profitability of beef cattle production. Genetic material must be spread around the breed to increase the economically important traits. In looking at sire evaluation data, our main considerations are to evaluate and rank the different bulls within the various breeds on the economically important traits. When I look at beef cattle production, my three major concerns are:

1. Will they calve?

2. Will they grow?

3. Will they milk?

As we study sire evaluation data, we need to think about these three particular traits, because to most beef cattlemen in the United States in the cow-calf business these are the three traits that affect their pocketbook the most. Until feeders and packer buyers are willing to pay us for superiority on the rail, I am not too concerned about setting up elaborate selection programs for the carcass traits. If we do set up elaborate selection programs the industry must be paid for those programs. Currently in the United States, the way our buying

[1]Invited paper presented at Beef Improvement Federation Annual Meeting, Denver, Colorado, on April 30, 1980.

operates, no one producing superior cattle of this type is being paid for them. However, cow calf producers are currently being paid well for percent of calves alive and pounds at weaning which reflect both growth and maternal traits.

But back to the subject of sire evaluation data. I decided that one way to look at it was to take a look at what some of the major breed associations are doing today as far as utilizing sire evaluation data. Your question may be: "How are you going to tell whether they are utilizing it or not?" The only way I know how to answer this is to look at what genetic input they are using as the top sires in their breeds.

Let's have a look at the top ten bulls in registrations in the Angus breed of cattle. Here is a breed that has the largest number of cattle registered in the United States of any beef breed, and has had a completely open and unrestricted A.I. policy for the past several years. As you look at the registrations by the top ten bulls you will notice that these top ten bulls only account for 9,834 total calves. You will also note that the highest bull of the breed only sired 1,482 calves which makes up a .55% of the population registered in that year.

I don't believe we have to be too worried about inbreeding caused by A.I., because only 9,834 calves were sired by the top ten bulls in the breed and we are working here with a breed that has over 200,000 registrations per year. I also would like to point out the tremendous genetic diversity of bulls in the top ten. I am sure some of you think there are some bulls in there that would not fit into your breeding program. However, when we consider diversity, certainly the breed is using a wide array of different blood lines of bulls.

Now, let's take a look at progeny data on these bulls. I pulled the performance pedigrees on all of the bulls that were involved of the top ten. Let's look at yearling breeding value and maternal breeding value in this particular breed. As you can see the people are doing a relatively good job of selecting bulls that are superior in growth. Now I realize many of you will sit there and say there are some bulls in the group that are not high growth bulls, but when you analyzed them on an across-the-breed basis, these bulls are at least above average as far as yearling growth is concerned. As we look at maternal data, you can tell that the breed as a whole is probably trying to find the bulls that are going to have superior maternal performance. In this group of bulls it is interesting to note that the number three bull, Bor View Winton 1342, the number four bull, Rito 707 of Ideal 533 70, the number seven bull, MSU Black Revolution 165, were all progeny tested in the American Angus Association Superior Sire Program, and at least two of those bulls made it into the top ten because of superior data on that program. There are two or three of the other bulls here that made it into the top ten strictly because of showring winnings, and there are 2 bulls in there that made it into the top ten because they happen to be owned by extremely large cattle breeding organizations which utilized the bulls very heavily. This tells me that in this particular breed of cattle there have been people that have been interested in using some

Table 1. TOP 10 ANGUS SIRES BASED UPON NUMBER OF REGISTERED PROGENY

		No. of Registered Progeny	Percent of Total Registrations
1.	GREAT NORTHERN	1,482	(.55%)
2.	BLACK MARSHALL 482	1,206	(.45%)
3.	BON VIEW WINTON 1342	1,147	(.43%)
4.	RITO 707 OF IDEAL 533 70	1,008	(.37%)
5.	M S U FREESTATE 343	952	(.35%)
6.	SAYRE PATRIOT	873	(.32%)
7.	M S U BLACK REVOLUTION 165	853	(.31%)
8.	RITO 109 OF IDEAL 443 74	842	(.31%)
9.	ANKONIAN DYNAMO	774	(.29%)
10.	SOUTHOLM BAR LAD 50D	697	(.26%)
	TOTAL:	9,834	(3.64%)

Table 2. BREEDING VALUES OF TOP 10[a] ANGUS SIRES

		Yearling Breeding Value	Maternal Breeding Value
1.	GREAT NORTHERN	100	102
2.	BLACK MARSHALL 482	106	103
3.	BON VIEW WINTON 1342	104	102
4.	RITO 707 OF IDEAL 533 70	104	106
5.	M S U FREESTATE 343	102	96
6.	SAYRE PATRIOT	100	103
7.	M S U BLACK REVOLUTION 165	102	99
8.	RITO 109 OF IDEAL 433 74	103	97
9.	ANKONIAN DYNAMO	102	105
10.	SOUTHOLM BAR LAD 50D	106	100

[a]Based upon number of registered progeny.

of the sire evaluation data, and that bulls that do come through with excellent data do have an opportunity to increase their semen sales and make an impact on the breed.

Now let's have a look at Polled Herefords. I might point out that this is 18 months of registrations because that was their last fiscal year. It will still give us the same trends and percentages. As you can see, the top ten bulls in the Polled Hereford breed in 18 months sired 7,006 registered progeny. The top bull accounted for .62% of total registrations, even though I hear a lot of Polled Hereford breeders saying that there is probably only going to be one or two lines in the near future. If you study this you realize that there is a little more variability, however, not as much as there is in the Angus breed. There are about four or five of these bulls that originated from the Jones herd, and the rest of these are Canadian bulls. The base of the top 10 Polled Hereford bulls is probably more narrow than some of the other breeds.

The other interesting thing is that all but one of these particular bulls in the top ten has been analyzed through their Gold Seal Program. With the exception of two of these bulls they have all made the Gold Seal Award. Analyzing this, you see that three, four or five of them made it into the top 10 because their popularity was actually from the show ring first. Because of show ring popularity, they also were progeny tested and ended up being relatively superior bulls. There are some other bulls on these particular lists that have really made it strictly because their progeny have excelled in the economically important traits. So I don't think that it is much different than in any other breed of cattle, as we have the people looking at not only performance data but at what they look like.

Now, let's take a look at the Simmental breed. Here is a breed that has always had completely unrestricted A.I., has an extremely complete sire evaluation program in utilizing their National Sire Summary and also has a tremendous amount of data available to their breeders. If you take a look at the top 10 bulls in the Simmental breed, you will notice that these top 10 bulls account for 12,987 head of cattle which represents 23.6% of all of the registrations in the Simmental breed. You can tell from this that the Simmental breed's top 10 bulls are having a lot more effect upon the population than the top 10 bulls in the Angus or Polled Hereford breed, due to the fact that they have complete sire evaluation data. This sire evaluation data is all field data. However, the accuracy is extremely good, and, after you get enough calves by a bull, you do not have one of them falling out of bed.

If we take a look at the data on the bulls that the Simmental breeders have been utilizing, I think you can see that, as a whole, they are a relatively select group of bulls. The other interesting point is that we hear a lot of Simmental breeders saying "well we are going to cut the growth rate down and go for more calving ease." However, after you analyze what the sires of the majority of the calves in the country

Table 3. TOP 10 POLLED HEREFORD SIRES BASED UPON NUMBER OF REGISTERED PROGENY

		No. of Registered Progeny	Percent of Total Registrations
1.	WSF PRL JUSTA BANNER	1,593	(.62%)
2.	S GILEAD 115	1.038	(.4%)
3.	VINDICATOR	776	(.30%)
4.	RWJ VICTOR J3 212	701	(.27%)
5.	VICTORIOUS K47-U81	574	(.22%)
6.	ENFORCER 107H	521	(.20%)
7.	L.S. BEAU VICTOR 130	496	(.19%)
8.	KIYIWANA NEW TREND	444	(.17%)
9.	STANNS MR. BEEF 2F	442	(.17%)
10.	RWJ VICTOR J3 168	421	(.16%)
	TOTAL:	7,006	(2.7%)

Table 4. APHA GOLD SEAL DATA ON TOP 10 POLLED HEREFORD BULLS

		365-Day Weight EPD Ratio	Lean WDA EPD Ratio
1.	WSF PRL JUSTA BANNER	102.5	104.2
2.	S GILEAD 115	97	97.1
3.	VINDICATOR	102.6	100.7
4.	RWJ VICTOR J3 212	106.1	103.4
5.	VICTORIOUS K47-U81	102.5	102.1
6.	ENFORCER 107H	103.1	101.8
7.	L.S. BEAU VICTOR 130	NO DATA	
8.	KIYIWANA NEW TREND	99.9	102
9.	STANNS MR. BEEF 2F	102.5	101.8
10.	RWJ VICTOR J3 168	102.6	102.8

Table 5. TOP 10 SIMMENTAL SIRES BASED UPON NUMBER OF REGISTERED PROGENY

		No. of Registered Progeny	Percent of Total Registrations
1.	SIGNAL	3.713	(6.7%)
2.	GALANT	1,826	(3.3%)
3.	ABRICOT	1,460	(2.6%)
4.	CEZON	1,360	(2.4%)
5.	KING ARTHUR	1,232	(2.2%)
6.	BEAT	1,068	(1.9%)
7.	TONI	957	(1.7%)
8.	LOCOMBE ACHILLES	859	(1.5%)
9.	EXTRA	776	(1.4%)
10.	RENZ	736	(1.3%)
	TOTAL:	12,987	(23.6%)

Table 6. PROGENY DATA[a] TOP 10 SIMMENTAL SIRES

		Calving Ease Index	Yearling Weight Ratio	Maternal Ability[b]
1.	SIGNAL	98.97	102.64	101.84
2.	GALANT	99.19	100.53	101.69
3.	ABRICOT	100.75	101.05	101.48
4.	CEZON	98.53	101.57	100.54
5.	KING ARTHUR	95.97	103.15	101.03
6.	BEAT	97.84	101.22	100.75
7.	TONI	97.28	99.94	99.79
8.	LACOMBE ACHILLES	98.51	99.41	100.39
9.	EXTRA	95.57	102.57	99.45
10.	RENZ	98.56	102.84	99.43

[a]Source: 1979 National Simmental Sire Summary.

[b]Daughter's first calf weaning weight ratio.

are, you can soon see that really the emphasis of Simmental breeders today is on growth rate and they must not be nearly as concerned about calving ease as some of the people I hear around the country. As you analyze this particular top 10 bulls, the majority of them are plus on maternal, all but two are plus on growth, and only one of them is plus on calving ease. I think it pretty well points out that, even though we hear some Simmental breeders and other people saying that the breed has calving problems, from this indication of the breeders as to what the selection criteria they are using in their particular breed of cattle is, first they want growth, next maternal, and are probably least worried about calving ease.

After we have looked at these particular beef breeds, I thought it would be interesting to take a look at the Holstein breed of cattle as to what they are doing in the sires of the population. We would all agree that the Holstein breed has made about as much progress in selecting traits as any breed of livestock has done. We realize that in the Holstein breed we are probably making 150 to 200 pounds of improvement for genetic milk per year across the population.

I was not able to obtain the numbers of all the calves; however, I was able to obtain the numbers of sons that were being registered by the different bulls. You will see here that 33.7% of the sons are sired by the top 10 bulls in the Holstein breed. You will also see one bull up on top, Elevation, that accounted for 10.3% of all of the Holstein bull calves registered in the United States in 1978. That particular bull is going to have an extreme impact on the breed of cattle as many of his sons have gone into A.I. studs and also into many leading herds. You will usually find if you analyze Holstein data over the years that there are one or two bulls every year that are extremely high. However, it does not really seem to be causing an inbreeding problem in the breed, because, after a bull is up there for about two years, another one takes over.

Let's take a look at the Holsteins as to what kind of genetic merit they were utilizing with these 10 bulls. You can see this is a relatively high group of bulls. Actually when we look at the predicted difference weighted for the number of sons, the average son of the top 10 bulls would have a PD of 1,200 pounds of milk, +.91 type. So I think you can see that one of the reasons that the Holstein breed has made as much impact and genetic progress is that the sires of the next generations are the exceptional bulls of the present generation. I would question whether in the United States in the beef cattle circles today we are really testing the right young bulls, because we have had proven bulls in many of the breeds over the last five or six years that really have excellent data on them. We in the beef cattle business are not as inclined to go out and find sons of these superior bulls as the people in the dairy cattle industry are. In the dairy cattle industry it is almost mandatory that the sire must be a truly superior bull.

I realize that we have performance data with which to evaluate young beef bulls. I do, however, believe that in the very near future

Table 7. TEN LEADING HOLSTEIN SIRES BASED UPON NUMBER OF REGISTERED SONS

		No. of Registered Sons	Percent of Bulls Registered
1.	ELEVATION	2,529	(10.3%)
2.	ASTRONAUT	1,317	(5.3%)
3.	GLENDELL	844	(3.4%)
4.	CONDUCTOR	684	(2.8%)
5.	COMMANDER	620	(2.5%)
6.	TIPPY	568	(2.3%)
7.	MILU	458	(1.8%)
8.	BOOTMAKER	437	(1.7%)
9.	VIRGINIAN	430	(1.7%)
10.	GAY IDEAL	387	(1.5%)
	TOTAL:	8,271	(33.7%)

Table 8. PREDICTED DIFFERENCE FOR MILK AND TYPE OF TOP 10 HOLSTEIN BULLS

	Predicted Difference For Milk	Predicted Difference For Type
1. ELEVATION	+1520	+1.59
2. ASTRONAUT	+ 737	+ .80
3. GLENDELL	+1777	+ .86
4. CONDUCTOR	+1663	+1.05
5. COMMANDER	+ 794	+ .30
6. MILU	+1035	+ .78
7. BOOTMAKER	+1269	+ .24
8. VIRGINIAN	+ 507	- .33
9. GAY IDEAL	+1159	- .3
WEIGHTED AVERAGE:	1200	.91

bulls that perform exceptionally well, but are sired by bulls that do not have high breeding values, will probably go to commercial men. It has been my experience that those kind of bulls are certainly a poor risk to get superior proven bulls. The dairy cattle industry has done a very excellent job of showing us the way as to breed better cattle.

Now, let's get back to the subject of how we are going to utilize sire evaluation data if we are a purebred breeder. One of the first things that every breeder must realize is that the perfect bull has not yet been born or tested and never will be. Many people had grandiose ideas when sire testing came along that a bull would emerge from the sire programs that would answer all of their ills. He would be the easiest calving bull, the best growth bull, the best maternal bull, and his cattle would be large framed and they would be well accepted. But as purebred breeders you must realize you are going to have to breed cattle in pieces. You must look at your cow herds and decide which particular traits you need to emphasize the most. Then you need to select bulls whose progeny data are superior in those particular traits, and you probably need to put independent culling levels on the other traits. If you are a breeder that has problems with milk, you are going to have to seek out bulls that are superior in milk, and you must make a decision as to how much growth, how much calving ease, or how much cutability you are willing to give up to get maximum milk production. You might not have to give up a lot. However, in some breeds of cattle currently you might have to give up quite a bit of growth or calving ease to get the top maternal cattle with the breed. So, when you are analyzing sire evaluation data, remember that you need to be utilizing the bulls that are available to you and utilize them for what they are. Don't try to find the perfect bull. If you need to increase growth rate in cattle, then you are going to have to utilize the bulls that are superior in growth, and you also have to make a decision as to how much calving ease you are willing to sacrifice.

One of the other things we need to think about is that the bulls that survive the progeny test programs of the different breed associations are really superior bulls. I heard a breeder say approximately six months ago, "Well none of the bulls tested are really any different". I was shocked to hear this! I have tested a lot of bulls. I have worked with sire testing programs for the last 13 years, and I can see the difference in these bulls even though the data that we compiled does not look like there is that much difference between them. When you realize what a bull that is +30 pounds on yearling weight is going to do to a set of calves, you realize that there are some true differences in these bulls. I think that one of the problems that we have had in the past is that people get biased. They feel a particular bull of a particular blood line cannot be that good because they didn't come out of a high performance line. Good performance cattle can be found anywhere. I don't care how they have been bred. Because of genetic variation, you can get good performing cattle in any line. If they are of a different line you ought to be utilizing them if they have the data to back them up. It gives you some genetic variability to work with, and I think we all need to be concerned about keeping our base as wide as we possibly can.

One of the other things that I get very upset about is that the A.I. industry has been a very strong supporter of progeny testing programs and has tested many bulls in the different sire evaluation programs. Some of the supposedly top purebred performance breeders in the United States have said: By the time you guys get a bull tested, we are already past him". That is a bunch of B.S., because most of the bulls that are being progeny tested today are only three to four years of age. Those truly superior bulls I'll guarantee you haven't been passed. I can't understand why quite a number of the top performance breeders in the United States do not utilize the top bulls coming out of National Sire Evaluation Programs. I don't truly believe that they have passed them yet, as I see bulls that are eight, nine and 10 years old still holding their own against many of the supposedly so called "Young Superior Bulls" when they are being progeny tested. If you will analyze the progeny data from the different breeds, you will see that we are not making nearly as much genetic advancement as we once thought we were . The reason is that we are not dumping enough of those truly superior bulls back in the population to get the right sons to be tested. If your theories were right, then the young bulls that are being tested today would be literally mopping up the older bulls. As I analyzed the National Sire Evaluation Program in the different breeds, there are some of the old work horses that are still sitting on top of the lists. The bulls that survive the progeny testing program are really going to turn the crank. If you are not utilizing these kind of bulls I don't think that you can make the genetic advancement in your herds of cattle that you would like. You are betting your herd of cattle against the whole population of a breed. The majority of the young calves that have gone into these young sire programs are the top of many test stations and also the top bulls from individual herds that have done a superior job in selection for the economically important traits.

One of the other things you need to do is, when you are selecting bulls to be utilized in your breeding program, don't put all your eggs in one basket with young bulls that just have come out with their first progeny data. This is especially true with bulls in the structured program where we only have 20 to 25 progeny available on them. Those bulls can and will move as we increase the progeny numbers. Never breed more than 25% of your cow herd to any one bull that has just come out with progeny data unless that particular progeny data has many more numbers than is currently being utilized.

After sitting back and looking at the sire evaluation programs my thoughts are this: The programs that are currently in use can be improved. However, they are so much better than what we had 10 years ago there is no comparison. We are finally getting the handle on the superior breeding bulls. The main concern I have is, not that we do much to improve the programs, but let's improve usage of the bulls in the programs. I think this is where the Beef Improvement Federation group as a total group could certainly play an important role. I get very concerned today that there are not many people in the United States who are involved with the purebred cattle business who are really believers in the National Sire Evaluation Program. I am extremely concerned that many of the extension personnel in the United States do not understand sire evaluation data and are not talking to their breeders about utilizing bulls that have superior data. I see everyone sort of having their own bailwick and being interested in promoting a particular breeders bull, but not looking at the whole national scope. If we look at the reason that the Dairy Sire Evaluation data has been utilized, one of the real strong points is that people in the extension programs in the United States were the best supporters and best promoters of sire evaluation data. They got out and told the people that they ought to be using bulls that have a plus predicted difference for milk.

As I travel across the United States and work with many extension people, I do not get the feeling that this is happening in the beef cattle industry today. I really feel that extension has not played the part that it needs to if we want to get sire evaluation utilized in the different herds of purebred cattle in the United States. One of the other areas that we need to look at as far as getting the superior bulls utilized is that the breed associations need to be more totally committed to sire evaluation programs. And that is probably haressy for some of you, as I am sure all of you are saying, "well we have breed association programs". I fully agree and we cooperate with you, but one of the real problems is that you have not educated your membership. Many of you have not even educated your field staffs yet as to how to use sire evaluation and what it means. Many of you or much more of your staff and field personnel are much more interested in who won at the last national show than who are the bulls that are going to sire the superior economically traits in beef cattle production today. If you want to get the bulls that are superior in national sire evaluation programs utilized then it has got to start on the breed association level. We as an A.I. stud can promote and talk about it, but unless it gets the blessing of the different breed associations and an extremely strong push from those breed associations, it is not going to make a very big impact in the beef cattle industry. Every time I pick up a breed association magazine I see that there is still not a lot of emphasis put on progeny data and/or performance data.

Yes, we have come a long way. But folks, we have got a long way yet to go because the population of people that are breeding the purebred cattle in the United States today are still not breeding cattle on sound genetic principles. It really concerns me that they are not utilizing the sire evaluation data that they have in front of them today. We have all sat in our ivory towers and thought if we make this data available, everyone is going to use it. This is not true. We have had a tendency to make programs too complicated so the average purebred breeder cannot grasp them. So what does he do? He doesn't worry about breeding cattle in that manner. It is a lot easier for him to go to a show and see who the judge slaps, and that to him is the best bull. I think that in the next five years the major challenge of purebred breed associations, BIF, A.I. studs, and extension, is to come up with ways to simplify sire evaluation data so that we can give the breeders three or four numbers so they have a pretty good idea as to how a bull is breeding.

If I could just put a set of three numbers in our sire directory, one on calving ease, one on growth, and one on maternal ability, I am sure that we would have less confusion about the data that is available. Currently, we have to use data from three or four sources and we also use performance data on the bull himself, simply because each individual group wants different data. One of the problems that we have had is that we have tried to make it too complicated. Unless we uncomplicate the data, we will not have the purebred beef cattle industry wanting to use national sire evaluation programs.

We, as the leaders in the industry, must sell the merits of sire evaluation and if we do that the cattle will sell themselves.

PRESIDENT'S COMMENTS

Mark Keffeler

April 1980

Denver, Colorado

Honored guests, and ladies and gentlemen of the beef cattle industry.

My one room rural school education doesn't give me the confidence to speak to a group that has so many in attendance with doctorate degrees. I do not plan to give a speech that will be a great lesson on cattle breeding or performance testing. I do have a few thoughts to share in two areas.

1. The beef cattle business in general.

2. A brief look at BIF, its purposes and objectives.

It is very easy to get caught up in the doom and gloom feeling running throughout our nation right now. High interest rates, high inflation and low cattle prices are discouraging; in our area, add to the list a drought and a real grasshopper threat and it is easy to be discouraged. But I'm not! In fact, there are some things I'm encouraged about.

1. Top performance cattle are still selling well.

2. More buyers are studying performance records.

3. The performance selection of breeding stock today is going to have a great, positive influence on our cattle of the future.

4. Cattle numbers are down. We have our house in order. Pork and poultry are our big problems today. (A bumper sticker I saw humorously points up this problem. It read, "Help the beef industry--Run over a chicken").

About 20 years ago as a speech project, I was asked to look into the future, to the year 2000. An article I read then had me convinced there would be huge-monstrous machines that would move over our marginal or waste land, leveling the mountains and valleys, gobbling up the soil, sorting out the good and adding needed nutrients and lay out a perfect seed bed.

Well, that machine has not been built but just a few weeks ago, I saw two great tractors with big machines going over thousands of acres, up the hills and through the draws. The erosion was terrible and the road ditches full. The destruction seems beyond repair.

My view of the future is much different now. I see us getting back to working even more closely with nature. With native crops, pastures and ranges carefully managed, grass land that are best utilized by ruminants, like cattle. Practical, productive and efficient cattle can convert this great renewable resource to palatable and nutritious human food, much more reasonable than any master machine guzzling our scarce and expensive energies.

I believe the key word in the last paragraph is practical.

After my graduation from college with an animal science degree, I spent about six months in India as an IFYE student. What a shock! The cattle, even though they were used for milk and work, were left to wander the streets. Peacocks were eating the sorghum crop, and monkeys were so numerous in one village, special bars were needed on the windows to keep them out of the houses.

As I look back on this experience and compare it with what is going on in the United States today, I'm convinced that some hundreds or even thousands of years ago, the environmentalists got the upper hand in India. It could happen here.

The outside influences to our industry is staggering. I appreciate the efforts of NCA and all the other organizations that are fighting for our rights to stay practical and efficient. I hope everyone here is helping in his or her way to fight for our survival on the political front.

The other task to our practical cattle approach is to search out and use the animals that will give us maximum efficiency along with maximum productivity in their given environment.

This is something every cattleman likes to achieve, but often doesn't know where he stands until he finds his paydays are too small and too few.

Performance programs give us that handle on management decisions that can make our paydays bigger and better.

Now we are getting down to just why BIF and its more than 50 members exist. I'm not going to even try to predict the future. I doubt if anyone can accurately predict what will be ahead in the beef cattle business by the turn of the century. If someone would have said to me 20 years ago that "I would breed all my cows on one day and do it on a Saturday so the kids can help," I'd have said "you're crazy." In about 10 days we are going to breed a big share of our cows just that way.

I'm pleased to report that our revised guidelines are going to be to press soon. A special thank you to Dixon Hubbard and all the committees for completing this great task. It has been like planting Garrison creeping foxtail through a drill. It takes a lot of poking and prodding. Thanks again Dr. Hubbard.

The new guidelines are by no means an end or a final say on beef cattle performance procedures and measuring methods, but rather an up-date. New research and more complete analyzing of present data will no doubt help us to improve, and, yes, maybe even simplify some of our present methods.

Some things have not changed and those are BIF's five purposes. I think a review at this time would be in order.

1. Uniformity. To work for establishment of accurate and uniform procedures for measuring and recording data, which may be used by participating organizations, concerning the performance of beef cattle.

I'm sure uniformity was one of the beef cattle performance objectives that was uppermost in the minds of our founders, and I believe one of the purposes that has seen the most success. I now have very little difficulty in understanding programs from many organizations who process or report records. Continuing research and study may help us to make our procedures even more accurate and meaningful.

2. Development. To assist member organizations and/or their affiliates in developing their individual programs consistent with the needs of their members and the common goal of their record keeping programs.

Fledgling performance groups are a lot like my four year old son. They ask a lot of questions, but I also notice as they get older the questions get harder and they ask a lot more "whys". This points up more need for research and analyzing data.

3. Cooperation. To develop cooperation among all segments of the beef industry in compiling and utilizing performance records to improve efficiency in the production of beef.

I never cease to be amazed at the tremendous cooperation between breeders, breed organization, state BCIA's, researchers, extension workers, AI studs, and everyone interested in beef cattle as there is at a BIF meeting. This interchange of ideas is a benefit to everyone and to the beef industry as a whole.

4. Education. To encourage members to develop educational programs emphasizing the use and interpretation of performance data in improving the efficiency of beef production.

Now, here is an area that I see needs much more work. I'm sure the new guidelines will be a help and I ask everyone who has the opportunity to use them for educating our cattlemen about performance testing. I recently served on an advisory committee for our state 4-H meat animal project review. It was the unanimous opinion of everyone on our committee that beef cattle performance should be worked into the 4-H program and that the present show ring emphasis lacked a great deal in teaching the young people practical beef cattle production. The mechanics of setting up an attractive performance oriented program was our stumbling block. I believe BIF should look at some youth programs. The beef cattle performance movement could certainly benefit from youth involvement.

5. Confidence. To develop increased confidence of beef industry in the economic potential of performance testing.

We are gaining and I'm encouraged. The expanded education we just talked about will help even more. I like to compare the evolution in the acceptance of beef cattle performance to what I have observed in one families attitude in buying bulls. This includes three generations from this family; grandpa, dad, and now the sons. This evolution falls into five periods:

1. Scoffed at it.
2. Ignored it.
3. Showed polite interest but didn't understand it.
4. Made an honest effort to figure it out.
5. Devour every bit of information we can put before them.

I only hope we can increase the number who fall into the fifth category.

I want to take this opportunity to thank you who had confidence enough in me to get me actively involved with BIF. It has been a great education for me. I'm sure I've gained much more than I have given. It has given me the chance to become acquainted with the finest people in the beef cattle industry.

A very special "thank you" to Art Linton, who has made my job as president so very easy.

I would like to end with the following poem.

Beef Cattle Performance - 1980
Author - (He won't admit it.)

Performance testing is coming of age,
Even though it hasn't swept the country with rage.

The inroads we've made are satisfying indeed,
As a few more cattlemen are taking the lead.

To tell the story of performance testing success.
While not always making a profit, at least our losses are less.

WHAT STATE BCIA's SHOULD BE DOING

I have been involved in the performance movement most of my professional career. This experience has, at times, been rewarding; and other times, frustrating.

I have seen a tremendous improvement in cooperation and communication among organizations that provide producers with performance testing services. This includes the formation of the Beef Improvement Federation and the development of "Guidelines for Uniform Beef Cattle Improvement Programs."

I have seen significant improvement in the credibility of people who performance test beef cattle as well as the cattle they produce. I have seen the demand and monetary value of performance-tested seedstock improve dramatically.

I have witnessed the acceptance, development of strong performance testing programs, and promotion of these programs by breed associations, including sire evaluation. I have seen a few BCIA's grow and prosper. However, the most rewarding thing I have witnessed in the beef cattle performance movement is that a few elite seedstock producers are seriously pursuing improvement of their cattle by vigorously applying performance in selection. Thus, there will be superior seedstock in the future to insure prosperity of the beef industry.

On the other hand, I know of previously strong BCIA's that are dead or dying. I know of others that are barely holding their own. The majority of beef producers who performance test do not effectively utilize their records to improve their herds. Many producers use performance testing primarily as a sales gimmick, especially central testing. Most producers never mature to whole herd testing. Many performance programs have become enslaved to a computer program and because of cost can't make needed changes. Some highly-respected and nationally-known producers of performance-tested seedstock run bulls year-round and pay little attention to reproductive performance. Superior-performing feeder calves and yearlings seldom receive their true value at the market.

We haven't been successful in getting a very high percentage of producers to participate in performance testing programs, especially commercial producers. Some people say this is not too important. However, unless there is a tremendous increase in the use of A.I., there are not near enough performance-tested bulls to breed the national cow herd or demand for these bulls if they were available. Thus, I think we have considerable room for expansion if we could only figure out how to develop demand for this product. If profit is the primary motivating force in

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Presented by Dixon D. Hubbard, Program Leader-Animal Science, USDA, SEA-Extension, Washington, DC, at the annual meeting of the Beef Improvement Federation, Denver, CO, April 29-30, 1980. Presented to the Seedstock Committee.

the cattle business and performance testing significantly increased profit, it would then appear logical that more producers would performance test. One would think commercial producers at least would use performance-tested bulls and save the best heifers for replacements if it was profitable.

What is wrong with our product? Or what is wrong with our programs? Why don't more seedstock producers performance test? Those who do, why don't they effectively utilize their data? Why don't more commercial producers use performance-tested bulls? If we can answer some of these questions, then possibly it will give us some ideas as to what we can do to improve BCIA programs. The things I will say relative to these questions will not be in any particular order of priority, but in the order they came to my mind as I developed this presentation.

The first thing that came to mind was, most seedstock producers don't really have a sound performance testing program that methodically provides for continuous improvement. They're not zeroed in on specific goals and turning generations as rapidly as possible in pursuit of that goal. They change their breeding program from year to year not in accordance with their performance data but in accordance with the hottest selling line in the breed! Thus, the performance of their herd goes up and down like a yo-yo, and they can't provide the commercial producer with a product that is consistent in increasing the productivity of his herd. Some purebred performance-tested bulls produce progeny with as much variation in size and conformation as crossbred bulls. As a commercial producer, I don't want to buy bulls that have just been performance tested. I want to buy performance-tested bulls that are backed by a sound and progressive herd improvement program. Otherwise, I feel like I am buying a "pig in a poke".

The next problem I thought of was, the indiscriminant selection for growth by most seedstock producers who performance test. I think all of us are aware of the high correlation between birth weight and growth rate. Thus, the beef industry is plagued with the highest level of dystocia that's ever existed in our history. This is not a problem of any particular breed but all breeds. Commercial producers have revolted against this problem. Veterinarians are recommending against performance-tested bulls. Seedstock producers who have birth weight data are finding that commercial producers are now willing to sacrifice considerable growth rate for a lighter birth weight. Seedstock producers have really dropped the ball in this area because there are cattle with acceptable birth weights that have good growth rates. However, they haven't been selecting for these cattle, and the pendulum has already swung. Now, they are having to hurry to catch up!

As a commercial producer, I am not going to stay with my cows night and day during calving season. I want cattle that work for me rather than cattle I have to work for! Also, cows contribute to birth weight, so I don't want to save heifers from cow-killing bulls. There is more money to be made with a 95 percent calf crop weaning at 475 lbs. and minimum calving problems than with an 80 percent calf crop resulting from calving difficulty even if they wean at 600 lbs. Some seedstock producers may have cows that can have 90- and 100-lb. calves without any difficulty; but I can assure you the average commercial herd will have a heap of trouble with calves that size, especially with first-calf heifers. One could say proper management would easily correct this problem. True! However, when you consider the fact that the average cow herd in this country is still less than 40 head, one bull units without facilities to handle a split herd prevail. Thus, many of the management procedures to prevent dystocia in frist-calf heifers are not going to be utilized. Rather, most commercial producers are going to correct this problem through the bulls they use.

The next thing that came to mind was, the most important factor in economical beef production is producing live calves from a high percent of the cow herd and then getting them to market. Performance data on cows that don't calve regularly or at all or lose their calf.at birth is very revealing.

It doesn't take me but a few minutes on my "Oklahoma calculator" (a Red Chief tablet and a wooden pencil) to determine "there ain't no profit in cows that don't wean calves." We are going to have to get serious about reproductive efficiency. I really don't want a bull from a seedstock herd that wouldn't be profitable as a commercial herd, and commercial cows that don't calve every year are not profitable. Thus, I want to see the calving data on the herd from which I buy bulls. I calve my cows within 90 days or less, and I don't want to produce replacement heifers from a bull whose mother has been allowed to calve whenever she wants. I don't care if every calf a cow produces is a potential herd sire. If she doesn't produce a calf every year at about the same time, I'm not interested in any of her progeny in my herd.

Another thing a lot of seedstock producers do that is very questionable is pampering cows. There are vast differences in how hard cows work at making a living and having calves. Pampering cows, helping them do things they should do by themselves, ultimately results in a herd of lazy "rips" that produce progeny that are a detriment to the commercial cattlemen. I sure don't want any replacement heifers from a bull from a pampered herd. When I have a cow that lays down to calve, I want her to work at it with gusto and keep working at it until she either has the calf or dies trying! What I am saying is, the management system under which a bull is produced is just as important to me as is his performance record. Thus, I think BCIA's need to get involved in collecting management data as well as performance data.

Different management systems support different levels of performance. It's no more justifiable to expect inferior management systems to profit from superior breeding animals than for superior management systems to profit from inferior breeding animals. We can do a commercial producer an injustice by selling him superior-performing bulls and encouraging him to save replacement heifers from these bulls if he is not willing to adjust his management to accommodate an increased level of performance. The next thing that happens to him is low reproductive efficiency which he blames on performance-tested seedstock. It isn't the cattle's fault; he just didn't give them a chance. However, his pride will seldom let him admit this, so performance testing gets a black eye.

Most BCIA's as well as breed associations have a single program. These programs are relatively complex and frequently take more time and provide more data than is needed by everyone who wants to performance test, especially beginners and commercial producers.

Do you remember what went through your mind when you first started performance testing? Do things seem as complex now as they did then? BCIA's need a program that provides a producer the opportunity to start simple and evolve to the more complex. Some commercial producers probably should never do anymore than tie themselves to a breeder who has a good progressive performance program, buy bulls from him, and save their growthiest heifers at weaning. If they do this along with pregnancy testing and culling open cows, it provides them with a simple system that will insure progress. In this regard, even if I don't performance test, I have to understand performance testing to be able to intelligently buy bulls and select replacements. Thus, a BCIA should have a strong educational program in cooperation with Extension designed to educate potential buyers of performance-tested breeding stock independent of whether they ever plan to performance test their herds.

Presently, most BCIA programs are designed for the well-educated seedstock producer, and I don't think this is sufficient.

One of the biggest problems in performance testing has always been turnaround time on data. Gathering cattle to collect performance data and then gathering them again to cull and sell based on this data has been a real detriment to the performance movement. I believe the solution to this problem is close at hand if we can marry our centralized data system to a mini-computer or programmable calculator system. This would allow the best of both worlds. Producers could have enough data at weaning time to cull their cattle as well as complete data on their herd in a central system which could be used for herd summaries, calculating lifetime performance, and identifying outstanding breeding animals.

The cost of computer programs and changing these programs has been a real problem for BCIA's. Many BCIA's are enslaved to their program. Rather than the program serving them, it has them boxed in and stalemated because of the cost required to make changes. At the same time, there is excess computer time available for performance data.

It's time that BCIA's set down with breed association and Extension personnel and work out procedures for inputting data into breed association computers, accessing these computers for data on herds in their States, and develop an Extension program that would increase participation in these programs and increase the educational value of data from these programs. Even though this will take time, patience, and hard work, the mutual benefits to all parties are well worth the effort. However, of greater importance is that this three-way partnership between BCIA's, breed associations, and Extension would maximize the strengths and minimize the weaknesses of each organization in delivering performance testing programs to producers. If being as responsive as possible to cattlemen is our common goal in performance programs, there will be more cooperation in this area.

Central testing has some limitations. Producers who plan to optimize the performance of their herds must someday come to the realization that they must whole-herd test. Then comes the question of sacrificing data by putting bulls in central test. I truly believe there is a place for central testing in the overall performance movement. Also, I don't think there is too much central testing capacity in the U.S. However, I believe there are some producers for which central testing is questionable and should be weaned from central testing. I may have "quit preaching and gone to meddling." However, if you truly analyze the situation, I think some breeders can't afford to central test bulls from the standpoint of maximizing the overall performance of their herds.

Merchandising superior-performing feeder cattle has been a problem. The age old cry that "we don't get paid what our cattle are worth" is still with us. About the only way this can be accomplished is through some system of retained ownership. I feel there is some potential for groups of producers to form cooperatives for merchandising superior-performing cattle for superior prices. BCIA's could play a major role in developing programs in this area.

We have recently been experimenting with a group-integrated production and marketing system in South Dakota and Wyoming that has given us some good information. However, there are several problems with this method of marketing that will have to be worked out before it can be considered as a viable alternative for merchandising a significant number of cattle.

<u>Summary</u>

1. Approach performance testing with a total management system concept.

2. Provide a program that is responsive to the needs of all producers from the simplest to the most complex.

3. Place as much emphasis on reproductive efficiency as you do on growth.

4. Provide data on the management system under which a particular level of performance was achieved.

5. Develop guidelines for commercial producers encouraging them to purchase performance-tested cattle according to the level of management they are willing to apply. Breeding stock that won't perform under their system damages credibility of performance testing.

6. Develop a State Beef Improvement Federation, with emphasis on cooperation in utilizing the strengths of all organizations providing performance testing services in your State, to increase producer participation in performance programs and provide Extension with all available data for educational purposes.

7. Investigate and pursue the utilization of breed association computer services. Work with them on procedures for directly inputting and accessing data for your State from their system. Work with them on standardization of forms and whatever else is necessary to achieve this objective.

8. Develop a system that ties mini-computers and programmable calculators to your centralized data system. This way you can have the best of two worlds--instant information for culling at weaning time <u>plus</u> complete data on herds and individual animals in the herd.

9. Provide seedstock producers, who central test, with information on the limitations of this procedure for improving total performance of their herd and help them graduate to a total performance program when it is merited.

10. Investigate procedures for merchandising superior-performing cattle.

11. Place emphasis on cattle that have superior growth rate and simultaneously have light birth weights.

12. Don't intentionally or unintentionally misrepresent your product. There is a lot of difference in animals that have similar performance data. Make sure that buyers understand the Most Probable Producing Ability of breeding animals they purchase.

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REPRODUCTION COMMITTEE REPORT

1980 BIF MEETING - DENVER

Merlyn Nielsen, Acting Chairman for Wm. Durfey
Michael Moss, Secretary
Andrew Boston, BIF Board Representative

Nielsen called the meeting to order. Fifty people participated in the committee discussions.

The Guidelines draft was reviewed for further inputs and corrections before final printing this summer. There was considerable discussion on the method of data recording for calving ease and calf livability. There was also considerable discussion on data collected for screening bulls for breeding soundness.

The Guidelines draft was not finished at the end of the session. The Executive Committee (William Durfey, Wayne Singleton and Merlyn Nielsen) will finish rewriting them. Unfortunately Durfey and Singleton had other schedule conflicts and were not in attendance at this meeting. Major changes to add to the draft copy provided by Dixon Hubbard recently are inclusion of descriptions of reproduction summarization procedures (e.g. pregnancy percent, calf crop weaned %, et.) and deletion of the scoring system of the bull breeding soundness evaluation outlined by the Society of Theriogenology. Since trained personnel doing these examinations utilize this procedure, and possible guidelines for this examination are expected to be improved, the committee felt it was best not to include the present scoring system in the Guidelines.

Other activity in the committee meeting was provided by Curtis Absher and Jim Brinks. Absher outlined his work in integrated reproduction management for our national extension program. Brinks reviewed present knowledge of genetic variation and covariation in reproductive traits and outlined sources of optimism for the future in research in this area.

Presented to the Live Animal Evaluation Committee at the 1980 B.I.F. meeting.

ACCURACY OF IDENTIFYING FEEDER CATTLE BY FRAME SIZE VERSUS BREED OR SIRE FOR PREDICTING SUBSEQUENT GROWTH AND CARCASS COMPOSITION

by

J. B. Gibb
University of Illinois

Much has been said in recent years about the relationship of frame size with growth and carcass traits. Interest in this area is keen as many individuals consider frame size to be an important trait when selecting breeding cattle. Right or wrong, the fact remains, cattle with large frames usually have faster growth rates and leaner carcasses than small-frame cattle at the same weight.

Also known through an abundance of research is that between breeds and within breed genetic variation is responsible for a certain portion of the observed differences among cattle.

With the present interest in frame size and breed and sire evaluation in mind, the purpose of this discussion is to present data indicating what percent of the total variation in certain growth and carcass characteristics may be accounted for by frame size variation versus genetic variation attributable to breed and sire within breed differences.

Shown in table 1 are the R^2 values for three mathematical models. Frame size was the sole main effect in the first model while breed was the only main effect included in the second model. The third model contained both breed and frame size as main effects. This model revealed whether or not additional information could be gained from using frame size in addition to a breed identification. Used in this study were actual data from the 1978 Great Western Beef Expo. All steers were measured as they went on test and frame size was derived using the Missouri frame size scoring system.

TABLE 1. MULTIPLE R^2 VALUES FOR GROWTH TRAIT PREDICTION MODELS[a]

	R^2		
	Frame size (FS)	Breed (B)	FS + B
ADG	.18	.36	.38
WDA	.69	.74	.74
RGR	.35	.51	.52

[a]Initial age, initial weight and initial heart girth to height ratio were covariates.

The breed model accounted for substantially more variation in average daily gain (ADG) and relative growth rate (RGR) than the frame size model. Breed also accounted for 5% more variation in weight per day of age (WDA) than frame size. The model containing both effects had R^2 values equal to or slightly larger than those for the breed model.

Similar differences may be seen in table 2 where the same three models are compared for the carcass parameters. The breed model accounted for 30%, 22%, 31% and 22% more variation in fat thickness (FAT), ribeye area (REA), estimated retail yield (ERY) and quality grade (QGR), respectively, than the frame size model.

TABLE 2. MULTIPLE R^2 VALUES FOR CARCASS TRAIT PREDICTION MODELS[a]

	R^2		
Trait	Frame size (FS)	Breed (B)	FS + B
FAT	.44	.74	.74
REA	.43	.65	.66
ERY	.41	.72	.72
QGR	.23	.45	.47

[a]Initial age, initial weight and initial heart girth to height ratio were covariates.

The results of this study support the relationship of frame size with growth and carcass merit, but imply that breed differences are much more important.

In two other studies evaluating the relationship of feeder cattle type with subsequent feedlot gain and carcass desirability, the interaction effect of height X breed had a statistically significant influence upon carcass weight (CW), ADG, RGR, FAT, REA and QGR. These results suggest that frame size is not an equally accurate indicator of growth and carcass merit across all breeds.

The results of a fourth study using data from 172 steers from the American Hereford Association National Sire Evaluation Program imply that sire differences within a breed account for more variation in growth and carcass merit than frame size. The R^2 values of models containing frame size, sire and frame size plus sire are shown in table 3 for ADG, WDA, FAT, ERY and QGR. Although the R^2 values are smaller, the general implications are very similar to those shown in tables 1 and 2 in that the sire model accounted for more variation in all the traits than the frame size model. In addition, frame size appeared to add very little to the model containing sire.

TABLE 3. MULTIPLE R^2 VALUES FOR GROWTH AND CARCASS TRAIT PREDICTION MODELS[a]

	R^2		
Trait	Frame size (FS)	Sire (S)	FS + S
ADG	.34	.46	.47
WDA	.51	.60	.60
FAT	.17	.25	.29
ERY	.11	.20	.22
QGR	.12	.31	.32

[a]Initial age, inital weight and initial heart girth to height ratio were covariates.

In conclusion, breed and sire within breed differences had more influence upon variation in the subsequent growth and carcass merit of feeder cattle than did differences in frame size. The following reasons may be cited:

1. Frame size may be a good indicator of growth and carcass merit in some breeds and not in others.
2. Certain sires within breeds pass on growth and carcass desirability to their progeny regardless of frame size.

NATIONAL SIRE EVALUATION

COMMITTEE REPORT

Larry Cundiff opened the National Sire Evaluation Committee meeting at 3:20 p.m., April 29, 1980. He noted that the committee will get together following the sire evaluation symposium to synthesize information obtained from the symposium. He then asked for specific comments on the guideline draft for the committee. Don Kress suggested that EPD be used instead of breeding value in the draft. Paul Miller suggested that BIF use either EPD or estimated breeding value. EPD is half breeding value. Discussion followed with the consensus being that BIF should be consistent, but 18 favored EBV and 15 EPD. The committee will discuss this further.

Open discussion was called for. Don Kress suggested that when progeny numbers were considered they be labeled minimum. Cundiff reported on the results of his sire evaluation programs summary. The results appear in Table 1 and Table 2.

TABLE 1. TRAITS REPORTED IN NATIONAL SIRE EVALUATION

Breed	Gest. Lgth.	Calv. Ease	Dau Wn. Wt.	Birth	Wean	Yrlg	WDA	Feed Eff.	USDA qual gr.	USDA yld. gr. (cut.)	Ret cuts per day
Angus		X	X	X	X	X			X	X	X
Charolais		X		X	X		X		X	X	X
Gelbvieh		X		X	X	X					
Hereford				X	X	X	X	X	X	X	
Limousin		X	X	X	X	X					
Pinzgauer				X	X	X					
P. Hereford				X	X	X	X		X	X	X
Red Angus	X			X	X	X				X	X
Shorthorn		X	X	X	X	X				X	X
Simmental		X	X	X	X	X				X	X

TABLE 2. REPORT ON NATIONAL SIRE EVALUATION

Breed	Type of Program	Number of Bulls Tested	Number of Reference Sires	Number of Herds	Number of Cows
Angus	Designed[a]	264	4	8	20/sire
Charolais	Breeder Operated[b]	73	12	13	1,120
Hereford	Designed	30/year	90	7	4,500
Limousin	Field Test[c]	250	100	4,000	50,000
Pinzgauer	Designed	10	10	8	2,000
P. Hereford	Designed	172	9	7/year	14,000
Red Angus	Designed	36	2	5	484 last year
Shorthorn	Designed	60	3	3	2,975
Simmental	Field	1,604	143	32,019	356,170

[a]Organization operated designed test: The organization sponsoring the program contracts with one or more test herds and supervises the conduct of the entire progeny test.

[b]Breeder operated designed test: The organization sponsoring the program specifies the conduct of the breeder operated progeny test and specifies the particular use of designated reference sires.

[c]Field test: These programs use the performance records available from on the farm or ranch performance programs to estimate expected progeny differences of sires.

Craig Ludwig asked if one program ratioed the bottom bull 100 and went up from there. The answer was yes, but they did this only once. Frank Baker recalled in 1968 the discussion on whether a national sire evaluation committee should be established. The results in so few years is remarkable. The committee adjourned at 3:50 p.m.

Submitted

R. L. Willham, Secretary

Station Name & Address	Total Brdrs Testing Bulls*	On-Farm No. Tested	On-Farm No. Brdrs	Central Test Station Capacity	Central Test Station Year Started	Central Test Station No. Tested	Central Test Station No. Brdrs
ALABAMA	44						
On-Farm Contact: Richard Deese, Extension Beef Cattle Spec, Auburn University, Auburn, AL 36830, 205/826-4377		500**	15				
Auburn University Bull Test, Dept of Animal & Dairy Sciences, Auburn University, Auburn, AL 36830				96	1951	89	23
North Alabama BCIA Bull Test, Florence, AL 35630, Mailing Address: Extension Hall, Auburn Univ, Auburn, AL 36830				100	1973	63	18
South Alabama BCIA Grazing Test***, Webb, AL 36376, Mailing Address: Extension Hall, Auburn Univ, Auburn, AL 36830				48	1979	43	12
**Doesn't include those tested through breed associations. ***New test on winter grazing without supplement.							
ARIZONA	22						
On-Farm Contact: Albert M. Lane, Extension Animal Scientist, University of Arizona, Tucson, AZ 85721, 602/626-1822		860	18				
Arizona Tuff Test Bull Station, Roy Crosby, Owner/Manager, Springerville, AZ 85938, 602/333-4477				160	1977	85	7
ARKANSAS	99						
On-Farm Contact: A. Hayden Brown, Extension Beef Cattle Spec, C102 Animal Science Bldg, University of Arkansas, Fayetteville, AR 72701, 501/575-3250		222	12				

*If a breeder is testing bulls at a central test station and on the farm = 1 Breeder.

1979 BIF BULL TESTING SURVEY

Station Name & Address	Total Brdrs Testing Bulls*	On-Farm No. Tested	On-Farm No. Brdrs	Central Test Station Capacity	Central Test Station Year Started	Central Test Station No. Tested	Central Test Station No. Brdrs
ARKANSAS (Continued)							
Fayetteville Bull Test Station c/o Dr. Hayden Brown Dept of Animal Science University of Arkansas Fayetteville, AR 72701 501/575-4351				60	1962	60	26
Hope Bull Test Station c/o Dr. William C. Loe Southwest Branch Expt Station Hope, AR 71801 501/777-8881				60	1962	103	41
Monticello Bull Test Station c/o Dr. Gerald W. Brown Southeast Research & Ext Center Monticello, AR 71655 501/367-3471				50	1977	45	20
CALIFORNIA	55						
On-Farm Contact: Ken Ellis Extension Animal Scientist University of California Davis, CA 95616 916/752-1278		56	12				
Bovine Test Center 11900 28 Mile Road Oakdale, CA 95361 209/847-6403				1000			
CBCIA Test #10						77	13
CBCIA Test #11						101	22
CBCIA Test #12						127	26
COLORADO	200						
On-Farm Contact: Art Linton Extension Beef Cattle Spec Colorado State University Fort Collins, CO 80521 303/491-6903		3000	200				
Four Corners Bull Test Hesperus, CO 81326 303/385-4574				240	1950	240	40

*If a breeder is testing bulls at a central test station and on the farm = 1 Breeder.

1979 BIF BULL TESTING SURVEY

Station Name & Address	Total Brdrs Testing Bulls*	On-Farm		Central Test Station			
		No. Tested	No. Brdrs	Capacity	Year Started	No. Tested	No. Brdrs
COLORADO (Continued)							
Northeast Colorado Bull Test Burdette Route, Box 59 Akron, CO 80720 303/345-6402				260	1976	260	98
Southeast Colorado Bull Test Colorado Beef Feedlot Highway 50 Lamar, CO 81052				200	1974	149	44
CONNECTICUT	-0-						
DELAWARE	-0-						
FLORIDA	9						
On-Farm Contact: Robert S. Sand Extension Beef Cattle Spec 402 Rolfs Hall University of Florida Gainesville, FL 32611 904/392-1916		332	9				
GEORGIA	70						
On-Farm Contact: M. K. Cook Extension Beef Cattle Spec University of Georgia Athens, GA 30602 404/542-2328		1200	60				
North GA Beef Cattle Eval Center Dr. Allen Ellicott Extension Animal Scientist P. O. Box 95 Calhoun, GA 30701				200	1969	130	41
Tifton Beef Bull Eval Station Dr. Clyde Triplett Extension Animal Scientist P. O. Box 1209 Tifton, GA 31794 912/386-3407				150	1957	146	71

*If a breeder is testing bulls at a central test station and on the farm = 1 Breeder.

1979 BIF BULL TESTING SURVEY

Station Name & Address	Total Brdrs Testing Bulls*	On-Farm No. Tested	On-Farm No. Brdrs	Central Test Station Capacity	Year Started	No. Tested	No. Brdrs
GEORGIA (Continued)							
Rollins Research Center P. O. Box B Mount Berry, GA 30149 (individual feeding)				95	1974	83	11
HAWAII	6						
On-Farm Contact: James C. Nolan Extension Beef Cattle Spec University of Hawaii Honolulu, HI 96822		107	5				
Hawaii Beef Cattle Improvement Association University of Hawaii Honolulu, HI 96822				24	1976	38	6
IDAHO	33						
On-Farm Contact: J. D. Mankin Extension Beef Cattle Spec Research & Extension Center Route 8, Box 8478 Caldwell, ID 83605 208/459-6367		1100	26				
K & E Bull Test Station Route 2 New Plymouth, ID 83655 208/278-3060				300	1979	250	7
ILLINOIS	130						
On-Farm Contact: Gary Ricketts Extension Animal Scientist University of Illinois Urbana, IL 61801 217/333-7351		420	60				
Beef Evaluation Station Dept of Agriculture Western Illinois University Macomb, IL 61455 309/298-1080				72	1972	70	53

*If a breeder is testing bulls at a central test station and on the farm = 1 Breeder.

1979 BIF BULL TESTING SURVEY

Station Name & Address	Total Brdrs Testing Bulls*	On-Farm No. Tested	On-Farm No. Brdrs	Central Test Station Capacity	Year Started	No. Tested	No. Brdrs
ILLINOIS (Continued)							
Beef Evaluation Station Dept of Animal Industries Southern Illinois University Carbondale, IL 62901 618/453-3725 or 618/453-2329				72	1975	63	43
Northwest Illinois Test Station R.R. #1 Lena, IL 61048				30	1976	30	16
INDIANA	180**						
On-Farm Contact: L. A. Nelson Extension Beef Cattle Spec Purdue University West Lafayette, IN 47907 317/493-9845		400**	100**				
Indiana Beef Evaluation Program Test Station*** Room 3-224, Life Science Bldg Purdue University West Lafayette, IN 47907 317/493-9845				180	1976	228	130**
**Estimated. ***Steers are also tested at the station in the Spring-Summer.							
IOWA	250**						
On-Farm Contact: Daryl Strohbehn Extension Beef Cattle Spec Iowa State University Ames, IA 50011 515/294-2240		950	42				
County Line Feeders Ralph Shields, Manager Eldon, IA 52554 515/652-3219				110***	1975	110	35
**An estimated 150-250 breeders process their records elsewhere. ***Commercial feedlot.							

*If a breeder is testing bulls at a central test station and on the farm = 1 Breeder.

1979 BIF BULL TESTING SURVEY

Station Name & Address	Total Brdrs Testing Bulls*	On-Farm No. Tested	On-Farm No. Brdrs	Central Test Station Capacity	Year Started	No. Tested	No. Brdrs
IOWA (Continued)							
Ehm Feedlot, Inc. Bill & Gary Ehm R.R. #2 Creston, IA 50801 515/782-5729.				360***	1973	360	75
Eugene Plager & Dennis Dolmage 805 12th Street Grundy Center, IA 50638 319/824-3586 or 319/824-5571				550***	1974	550	150
Don Kruse & Sons Feedlot Storm Lake, IA 50588 712/732-1119				120***	1975	120	30
Greig & Company R.R. #1 Estherville, IA 51334 712/362-3330				90***	1979	90	27
***Commercial feedlot.							
KANSAS	385						
On-Farm Contact: Keith Zoellner Extension Beef Cattle Spec Kansas State University Manhattan, KS 66506 913/532-6131		7550	385				
Kansas Bull Test--Beloit c/o Keith Zoellner Dept of Animal Science Weber Hall Kansas State University Manhattan, KS 66502 913/532-6134				400	1971	4341	175
Kansas Bull Test--Yates Center c/o Frank Brazle 20 South Highland Chanute, KS 66720 316/431-1530				250	1975	918	75
Silver Key Bull Test c/o Larry Stucky Route #1 McPherson, KS 67460				100	1974	605	20

*If a breeder is testing bulls at a central test station and on the farm = 1 Breeder.

1979 BIF BULL TESTING SURVEY

Station Name & Address	Total Brdrs Testing Bulls*	On-Farm		Central Test Station			
		No. Tested	No. Brdrs	Capacity	Year Started	No. Tested	No. Brdrs
KANSAS (Continued)							
Mid-Continent Bull Test Great Bend, KS 67530 Mailing Address: Leo McDonnell 2315 Colton Blvd Billings, MT 59102				250	1979	87	20
KENTUCKY	124						
On-Farm Contact: Russell BreDahl Extension Beef Cattle Spec University of Kentucky Lexington, KY 40546 606/258-2853		1222	87				
Kentucky Central Bull Testing Sta Eden Shale Farm Route #4 Owenton, KY 40359				135	1975	164	58
LOUISIANA	45						
On-Farm Contact: John S. Sullivan, Jr. Extension Beef Cattle Spec Louisiana State University Baton Rouge, LA 70803 504/388-2219		225	10				
Louisiana Bull Testing Station Dean Lee Ag Center Route 2, Box 20 Alexandria, LA 71301				192	1958	140	35
MAINE	-0-						
MARYLAND	22						
On-Farm Contact: William E. Kunkle Extension Beef Cattle Spec University of Maryland College Park, MD 20742 301/454-3732		6	2				

*If a breeder is testing bulls at a central test station and on the farm = 1 Breeder.

1979 BIF BULL TESTING SURVEY

Station Name & Address	Total Brdrs Testing Bulls*	On-Farm No. Tested	On-Farm No. Brdrs	Central Test Station Capacity	Central Test Station Year Started	Central Test Station No. Tested	Central Test Station No. Brdrs
MARYLAND (Continued)							
Maryland ROP Bull Testing Station c/o William A. Curry Jull Hall University of Maryland College Park, MD 20742 301/454-3732				80	1971	57	20
MASSACHUSETTS	-0-						
MICHIGAN	97						
On-Farm Contact: Amos Fox Dept of Animal Husbandry Michigan State University East Lansing, MI 48824 517/355-0327		120	70				
West Michigan Centennial Bull Test c/o Dept of Animal Husbandry 104 Anthony Hall Michigan State University East Lansing, MI 48824 517/355-0327				80	1974	62	27
MINNESOTA	171						
On-Farm Contact: Charles J. Christians Extension Beef Cattle Spec University of Minnesota St. Paul, MN 55108 612/373-1166		6243	171				
Minnesota Central Bull Test Sta Truman, MN 56088 Duane Prahl, Manager Charles J. Christians, Supvr. 101 Peters Hall University of Minnesota St. Paul, MN 55108 612/373-1166				125	1969	124	46

*If a breeder is testing bulls at a central test station and on the farm = 1 Breeder.

1979 BIF BULL TESTING SURVEY

Station Name & Address	Total Brdrs Testing Bulls*	On-Farm		Central Test Station			
		No. Tested	No. Brdrs	Capacity	Year Started	No. Tested	No. Brdrs
MISSISSIPPI	84						
On-Farm Contact: W. M. Swoope Extension Beef Cattle Spec Mississippi State University P. O. Box 5425 Mississippi State, MS 39762		800	60				
Northeast Mississippi Beef Evaluation Station (NEMBES) Dalton-Garner, Owner Booneville, MS 38829 601/728-6346				100	1979	54	24
MISSOURI	227						
On-Farm Contact: John W. Massey Extension Beef Cattle Spec University of Missouri Columbia, MO 65211 314/882-7250		2517	112				
Central Testing Station Keith Leavitt, Supervisor 125 Mumford Hall University of Missouri Columbia, MO 65211 314/882-2618 or 314/449-2217				160	1961	323	68
North Missouri Center RFD #1 Spickard, MO 64679 816/485-6576 or 314/882-2618				115	1971	110	15
Mark Twain Test Station Larry Coon, Owner Bethel, MO 63434 816/284-6473				200	1973	0	0
French Village Test Station French Village, MO 63036 314/358-3876 or 314/882-2618				108	1979	82	14
Ottman Test Station 701 Calhoun Rock Port, MO 64482 816/744-5333 (Brangus Only)				115	1978	75	18
B & M Performance Testing Station RFD #3 Warrensburg, MO 64093				80	1974	0	0

*If a breeder is testing bulls at a central test station and on the farm = 1 Breeder.

1979 BIF BULL TESTING SURVEY

Station Name & Address	Total Brdrs Testing Bulls*	On-Farm No. Tested	On-Farm No. Brdrs	Central Test Station Capacity	Central Test Station Year Started	Central Test Station No. Tested	Central Test Station No. Brdrs
MONTANA	370						
On-Farm Contact: Roger M. Brownson, Extension Animal Scientist, Montana State University, Bozeman, MT 59715, 406/994-3414		9000	175				
Treasure State Testing Station, c/o Russ Pepper, Box 217, Simms, MT 59477, 406/264-5694				109**	1968	109	30
Moiese Performance Bull Test Ctr, c/o Roy Snyder, Moiese, MT 59824, 406/644-2348				300	1963	173	30
Midland Bull Test Center, c/o Leo McDonnell, 2315 Colton Blvd, Billings, MT 59102, 406/656-5638				1150**	1963	1150	200
Herd Improvement Test, Inc., Box 250, Stanford, MT 59479, 406/566-2262				300	1969	299	35
**Commercial feedlot.							
NEBRASKA	136						
On-Farm Contact: Jim Gosey, Extension Beef Cattle Spec, University of Nebraska, Lincoln, NE 68583, 402/472-3574		2000	100				
Western Nebraska Beef Cattle Test Station, Ogallala, NE 69153, Bill Rishel, Manager, Box 1511, North Platte, NE 69101, 308/534-5305				425	1963	300	57

*If a breeder is testing bulls at a central test station and on the farm = 1 Breeder.

1979 BIF BULL TESTING SURVEY

Station Name & Address	Total Brdrs Testing Bulls*	On-Farm No. Tested	On-Farm No. Brdrs	Central Test Station Capacity	Central Test Station Year Started	Central Test Station No. Tested	Central Test Station No. Brdrs
NEBRASKA (Continued)							
Eastern Nebraska Beef Cattle Testing Station Gary Sierks, Manager Box 517 Schuyler, NE 68661 402/352-2883				180	1962	180	32
Central Nebraska Bull Test Jack Ludden, Manager Route 2, Box 281 Kearney, NE 68847 308/234-1479				300	1977	100	12
Nebraska Simmental Assn Bull Test Stapleton, NE 69163 Don Clanton, Manager Box 429 North Platte, NE 69101 308/532-3611				200+	1975	125	20
Nebraska Limousin Assn Bull Test Dean Jacobs, Manager 1202 Miles Court North Platte, NE 69101 308/534-9810				100+	1975	75	15
NEVADA	29						
Nevada Beef Cattle Improvement Association Univ of Nevada-Reno Main Sta Farm c/o William C. Behrens Extension Animal Scientist University of Nevada-Reno Reno, NV 89507 702/784-6644				150	1968	128	29
NEW HAMPSHIRE	-0-						
NEW JERSEY	10						
On-Farm Contact: Donald M. Kniffen Extension Animal Scientist Rutgers - The State Univ P. O. Box 231 New Brunswick, NJ 08903 201/932-9514		50	10				

*If a breeder is testing bulls at a central test station and on the farm = 1 Breeder.

1979 BIF BULL TESTING SURVEY

Station Name & Address	Total Brdrs Testing Bulls*	On-Farm No. Tested	On-Farm No. Brdrs	Central Test Station Capacity	Central Test Station Year Started	Central Test Station No. Tested	Central Test Station No. Brdrs
NEW MEXICO	30						
On-Farm Contact: Larry Foster Extension Beef Cattle Spec New Mexico State University Drawer 3AE Las Cruces, NM 88003 505/646-3706		300	5				
Tucumcari Bull Test New Mexico State University Box 3AE Las Cruces, NM 88003 505/646-3706				156	1961	156	25
NEW YORK	50						
New York State Bull Test Rm 110 Morrison Hall Cornell University Ithaca, NY 14853 607/256-7712				100	1978	55	50
NORTH CAROLINA	96						
On-Farm Contact: Roger L. McCraw Extension Beef Cattle Spec North Carolina State Univ P. O. Box 5127 Raleigh, NC 27650 919/737-2761		404	31				
Piedmont Research Station Route 6 Salisbury, NC 28144 704/278-2624				78	1973	103	46
North Carolina Central Bull Testing Station Eastern Carolina Livestock Arena Rocky Mount, NC 27801 919/446-9856				78	1969	83	31
Mountain Research Station 516 Test Farm Road Waynesville, NC 28786 704/456-7520				52	1980	0	0

*If a breeder is testing bulls at a central test station and on the farm = 1 Breeder.

1979 BIF BULL TESTING SURVEY

Station Name & Address	Total Brdrs Testing Bulls*	On-Farm No. Tested	On-Farm No. Brdrs	Central Test Station Capacity	Central Test Station Year Started	Central Test Station No. Tested	Central Test Station No. Brdrs
NORTH DAKOTA	171						
On-Farm Contact: M. A. Kirkeide Extension Beef Cattle Spec North Dakota State Univ Fargo, ND 58105 701/237-7646		4980	130				
Pelton Simmental Ranch Halliday, ND 58636				200	1978	106	41
OHIO	105						
On-Farm Contact: Randall R. Reed Extension Beef Cattle Spec Ohio State University 2029 Fyffe Road Columbus, OH 43210 614/ 422-6791		300	5				
Ohio Bull Test tation c/o Dr. Randall R. Reed The Ohio State University 2029 Fyffe Road Columbus, OH 43210 614/422-6791				225	1969	225	105
OKLAHOMA	400						
On-Farm Contact: Charles McPeake Extension Beef Cattle Spec Oklahoma State University Stillwater, OK 74074 405/624-6060		7500	100				
Panhandle State College Bull Test Milt England, Manager Box 186 Goodwell, OK 73939 (Purebred & 15/16's only)				150		300	60
Noble Foundation Bull Test Wayne Dobbs Route 1 Ardmore, OK 73041 (Purebred & Crossbred)				96		190	30

*If a breeder is testing bulls at a central test station and on the farm = 1 Breeder.

1979 BIF BULL TESTING SURVEY

Station Name & Address	Total Brdrs Testing Bulls*	On-Farm No. Tested	On-Farm No. Brdrs	Central Test Station Capacity	Central Test Station Year Started	Central Test Station No. Tested	Central Test Station No. Brdrs
OKLAHOMA (Continued)							
Connors State College Bull Test Gary Harding, Manager Box 424 Warner, OK 74469 (Purebred & Crossbred)				150		300	70
Oklahoma Beef, Inc. Charles McPeake Dept of Animal Science Oklahoma State University Stillwater, OK 74074 405/624-6060 (Purebred Registered Angus, Brangus, Charolais, Hereford, and Polled Hereford)				400	1973	758	200
Scott-Sand Test Station Murray Scott, Manager Route 2, Box 1251 Tonkawa, OK 74653 (Purebred Angus - First Priority)				80		160	40
OREGON	782						
On-Farm Contact: W. Dean Frischknecht Extension Beef Cattle Spec 212 Withycombe Hall Oregon State University Corvallis, OR 97331 503/754-4926		7150	782				
PENNSYLVANIA	58						
Pennsylvania Dept of Agriculture Meat Animal Evaluation Center 651 Fox Hollow Road State College, PA 16801				90	1966	88	58
RHODE ISLAND	-0-						

*If a breeder is testing bulls at a central test station and on the farm = 1 Breeder.

1979 BIF BULL TESTING SURVEY

Station Name & Address	Total Brdrs Testing Bulls*	On-Farm No. Tested	On-Farm No. Brdrs	Central Test Station Capacity	Central Test Station Year Started	Central Test Station No. Tested	Central Test Station No. Brdrs
SOUTH CAROLINA	58						
On-Farm Contact: John F. Wise Extension Beef Cattle Spec Room 144 P&AS Bldg Clemson University Clemson, SC 29631 803/656-3424		100	3				
South Carolina Bull Gain Test Station Room 144 P&AS Bldg Clemson University Clemson, SC 29631 803/656-3425				100+	1970	109	58
SOUTH DAKOTA	50						
On-Farm Contact: Francis (Mick) Crandall Extension Beef Cattle Spec 801 East San Francisco Rapid City, SD 57701 605/394-2236		2096	50				
TENNESSEE	40						
On-Farm Contact: Haley M. Jamison Extension Beef Cattle Spec University of Tennessee P. O. Box 1071 Knoxville, TN 37901 615/974-7294		575	40				
TEXAS**	28						
On-Farm Contact: L. A. Maddox, Jr. Extension Beef Cattle Spec Texas A&M University College Station, TX 77843 713/845-2051		822	17				
Luling Foundation Bull Test Sta Archie Abrameit Drawer 31 Luling, TX 78648				200	1980	0	0

**Incomplete Data.

*If a breeder is testing bulls at a central test station and on the farm = 1 Breeder.

Station Name & Address	Total Brdrs Testing Bulls*	On-Farm No. Tested	On-Farm No. Brdrs	Central Test Station Capacity	Central Test Station Year Started	Central Test Station No. Tested	Central Test Station No. Brdrs
TEXAS (Continued)							
Lone Star Test Center Sam Massey Wickett, TX 79788				300	1977	110	16
UTAH	73						
On-Farm Contact: Norris J. Stenquist Extension Beef Cattle Spec Utah State University Logan, UT 84322 801/752-4100 x7422		4575	40				
Utah Beef Improvement Assn Centerfield, UT 84622 801/896-4609 Nyle Matthews Test Station Manager Richfield, UT 84701 801/896-4675				250	1975	228	49
VERMONT	-0-						
VIRGIN ISLANDS	3						
On-Farm Contact: Harold Hupp Agricultural Expt Station College of the Virgin Islands Box 920 Kingshill, St. Croix, VI 00850 809/778-0050		90	3				
VIRGINIA	127						
On-Farm Contact: A. L. Eller, Jr. Extension Beef Cattle Spec Virginia Polytechnic Institute and State University Blacksburg, VA 24061 703/961-5252		751	42				
Culpeper Agricultural Enterprises Ken Whitlock, Manager Culpeper, VA 22701 703/825-9188				190	1958	161	51

*If a breeder is testing bulls at a central test station and on the farm = 1 Breeder.

1979 BIF BULL TESTING SURVEY

Station Name & Address	Total Brdrs Testing Bulls*	On-Farm No. Tested	On-Farm No. Brdrs	Central Test Station Capacity	Central Test Station Year Started	Central Test Station No. Tested	Central Test Station No. Brdrs
VIRGINIA (Continued)							
Red House Bull Evaluation Center James D. Bennett, Manager Red House, VA 23963 804/376-3567				285	1972	272	59
Berryville Test Fred Harner, Owner Berryville, VA 22611 703/955-1446				100	1977	35	14
WASHINGTON	70						
On-Farm Contact: William E. McReynolds Extension Beef Cattle Spec Washington State University Pullman, WA 99163 509/335-2511		1000	3				
Lacrosse Bull Test Station** Randy Taylor P. O. Box 204 Lacrosse, WA 99143 509/549-3840				260	1969	195	33
Columbia Bull Test Station Robert Lee Star Route, Box 57 Goldendale, WA 98620 509/773-5709				180	1974	50	10
Deets Polled Hereford Gold Performance Test Station** Dick Goetz 3068 Lampman Road Ferndale, WA 98248 206/384-1628				42	1977	29	7
George Campeau** 654 Upper Green Road Burlington, WA 92233 206/724-5924				40	1980	0	0
**Obtaining individual feed efficiencies.							

*If a breeder is testing bulls at a central test station and on the farm = 1 Breeder.

1979 BIF BULL TESTING SURVEY

Station Name & Address	Total Brdrs Testing Bulls*	On-Farm No. Tested	On-Farm No. Brdrs	Central Test Station Capacity	Central Test Station Year Started	Central Test Station No. Tested	Central Test Station No. Brdrs
WEST VIRGINIA	71						
On-Farm Contact: B. W. Wamsley, Jr. Extension Beef Cattle Spec West Virginia University Morgantown, WV 26506 304/293-3392		50	2				
West Virginia Bull Test Agricultural Science Bldg West Virginia University Morgantown, WV 26506 304/293-3391				250	1967	221	70
WISCONSIN	61						
On-Farm Contact: Wayne Wagner Extension Beef Cattle Spec University of Wisconsin 1675 Observatory Drive Madison, WI 53706 608/263-4304		144	14				
Wisconsin Bull Test Station Phil Wyse, Farm Manager Route 4 Platteville, WI 53818 608/348-8620 Wayne Wagner, Records University of Wisconsin Madison, WI 53706 608/263-4306				175	1958	171	53
WYOMING	41						
On-Farm Contact: C. O. Schoonover Extension Beef Cattle Spec University of Wyoming Box 3354, University Station Laramie, WY 82071		390	23				
Best Test West Dept F Route 2, Box 3160 Cody, WY 82414 307/587-5440		.		100+	1979	90	18
TOTAL	5112	70107	3031	14658		17686	3354

*If a breeder is testing bulls at a central test station and on the farm = 1 Breeder.

MINUTES OF BOARD OF DIRECTORS

BEEF IMPROVEMENT FEDERATION

Stouffer's Denver Inn

Denver, Colorado

April 29, 1980

The meeting was called to order by President Mark Keffeler at 7:00 a.m. on April 29, 1980. Those present included directors Bennett, Berg, Boston, Butts, Eller, Ellis, Eshelman, Farmer, Gosey, Holden, Hubbard, Keffeler, Linton, Ludwig, Martin, Peterson, Scarth, Schroeder, Shaw, Spader, Warwick and Baker. President Keffeler welcomed all those in attendance, especially Dr. Andrew C. Boston, representing Agriculture Canada, who was attending his first Board meeting.

Motion Minutes

The reading of the minutes of the mid-year Board of Directors meeting was dispensed with since they had previously been circulated to the directors. It was moved by Ludwig, seconded by Martin that the minutes be approved as circulated. Motion carried.

Finances

The financial statement was presented by Linton. He stated that the new billing process that was recommended by the Board at the May, 1979, meeting is working extremely well. A copy of the financial statement is attached. It was moved by Holden, seconded by Bennett, that the financial report be approved as read. Motion carried.

Guidelines

President Keffeler expressed thanks to Bill Taggert, Frank Baker and Dixon Hubbard for all of their hard work in preparing and distributing the draft copy of the revised BIF guidelines.

Hubbard stated that he hoped to have the final draft of the revised guidelines ready for distribution by early fall. He explained the review process that would be followed at the convention and then afterwards in preparing the final copy.

Tom Shaw brought up the problem of the yearling weight formula for central test stations that was adopted by the Board at the mid-year meeting. Considerable discussion followed about the merits of the two formulas. In order to avoid a stalemate in the committee meeting and ultimately in the preparation of the guidelines Baker made the following motion:

> "That both formulas could be published in the Guidelines, but that test station operators should publish which formula they use and justify their choice."

The motion was seconded by Eller. Motion carried.

Hubbard announced that Andy Boston would be serving as interim chairman of the Reproduction Committee in the absence of Bill Durfey.

1981 Convention

President Keffeler asked Linton for a report on plans for the 1981 convention. Linton reminded the Board that Ohio State University had extended an invitation to BIF to jointly hold a national beef performance symposium at Columbus, Ohio, in 1981 which the Board had accepted. However, since that time Dr. L. A. Swiger, who had developed the idea for the symposium, had resigned his position at Ohio State to become Department Head at VPI & SU. The Ohio group did not wish to host the symposium without Dr. Swiger, so they withdrew their invitation.

The Board had also approved Rapid City, South Dakota, as the site for the 1982 convention. Personnel changes in the South Dakota Extension Service were mentioned as a possible cause for reconsidering that convention. However, Keffeler reaffirmed the intent of the South Dakota BCIA to host the 1982 BIF convention.

Frank Baker extended an invitation from Oklahoma Beef to BIF to hold the 1981 convention in Stillwater in early April.

Andy Boston extended an invitation to BIF from Calgary, Alberta, Canada, for 1983.

Spader moved, Berg seconded, to table the final selection of the 1981 convention site until the Wednesday Board meeting. Motion carried.

New Business

President Keffeler reviewed the list of directors who were completing their terms. He also reminded the Board of the general business session to be held on Wednesday afternoon.

The meeting was recessed until 5:00 p.m., April 30, 1980.

Respectfully submitted,

Arthur C. Linton

Arthur C. Linton
Executive Director

BEEF IMPROVEMENT FEDERATION

FINANCIAL STATUS - JANUARY 1, 1980

by

Arthur C. Linton

	1-1-79	1-1-80
Checking Account	$ 158.16	$ 2,197.57
Savings Account	7,841.27	4,201.04
Certificates of Deposit		10,288.12
CSU Development Fund	75.97	165.47
TOTAL:	$8,075.40	$16,852.20

1979 BIF INCOME

Convention	$ 6,317.06
Dues	9,383.11
Proceedings	272.92
Interest	586.70
TOTAL INCOME:	$16,559.79

1979 BIF EXPENSES

Postage	$ 130.84
Copies	61.62
Printing	815.68
Supplies	9.84
Trophies	212.68
Board Meeting	415.66
Convention	
Printing	137.35
Postage	162.09
Xerox	61.75
Board Expenses	452.27
Meals	4,479.67
Breaks	500.54
Speaker Travel	343.00
	$6,136.67
TOTAL EXPENSES:	$7,782.99

MINUTES OF BOARD OF DIRECTORS

BEEF IMPROVEMENT FEDERATION

Stouffer's Denver Inn

Denver, Colorado

April 30, 1980

The meeting was called to order by President Mark Keffeler at 5:00 p.m. on April 30, 1980. Those present included directors Bennett, Berg, Borror, Boston, Butts, Eller, Ellis, Farmer, Gosey, Holden, Hubbard, Keffeler, Linton, Martin, Masters, Paschal, Peterson, Radakovich, Scarth, Schroeder, Shaw, Spader, Warwick, Baker and Cundiff.

President Keffeler extended a special welcome to the new and re-elected board members. They are:

BCIA's

Western - Bill Borror
Central - Mark Keffeler
East - John Masters
At Large - Steve Radakovich

Breed Associations

Dick Spader - American Angus Association
Joe Paschal - American International Charolais Association

Special thanks were extended to the retiring directors Bennett, Eshelman, Ludwig and Shaw for a job well done.

Election of Officers

Tom Shaw, chairman, gave the report of the Nominating Committee, which included the nomination of Jack Farmer as president. Glenn Butts moved that the nominations for president cease and that a unanimous ballot be cast for Jack Farmer. Motion seconded by Les Holden. Motion carried.

The Committee's nomination for vice president was Roger Winn. It was moved by Martin, seconded by Schroeder, that the nominations cease and that the Executive Secretary be instructed to cast a unanimous ballot. Motion carried.

Mid-Year Meeting

The location of the mid-year board meeting was discussed. Bill Borror moved, seconded by Andy Boston, that the mid-year meeting be held in Kansas City. Motion carried. The date of the meeting shall be October 10, 1980.

1981 Annual Meeting

The matter of the location for the 1981 annual meeting was again brought up for consideration. Invitations were extended from Stillwater, Oklahoma, and Sacramento, California. President Farmer called for a secret ballot. The Board voted to hold the meeting in Oklahoma by a vote of 10 to 6. While the exact dates shall be determined, the first week of April was recommended.

1982 Annual Meeting

It was reaffirmed that the 1982 annual meeting will be held in Rapid City, South Dakota.

1981 Meeting Program Idea

While on the subject of annual meeting locations and dates, ideas for meeting programs were also discussed. It was suggested that member organizations be surveyed for program ideas. Hubbard pointed out that since the BIF Guidelines publication will be current at that time that there should not be a pressing need for committee activity in the area of program revision. Instead, they may wish to direct themselves to the development of extendible materials.

Other ideas dealt with a symposium on mature size. Another one was related to a muscle biopsy technique.

A Program Committee was named as follows:

Dick Spader, Chairman
Greg Martin
Steve Radakovich
Frank Baker

Guidelines

President Farmer assigned responsibilities for the Guidelines publication. Review of the glossary is to be handled by Eller and Scarth. The preparation of the preface shall be the responsibility of Linton.

Committee Reports

The various committee reports was presented and discussed. None of them were in final form ready for publication in the proceedings. Spader moved and Berg seconded that Dixon Hubbard work with the executive group of each committee in finalizing the committee recommendations for the guidelines.

The Sire Evaluation Committee is to report to the mid-year meeting of the Board.

The meeting was adjourned at 9:00 p.m.

Respectfully submitted,

Arthur C. Linton

Arthur C. Linton
Executive Director

BIF AWARDS PROGRAM

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 Nygard	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
Wm. A. Stegner	ND	1976
U.S. Range Experiment Station	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
Milton Mallery	CA	1977
Jack Pierce	ID	1977
Mary & Stephen Garst	IA	1977
Odd Osteroos	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 and Wesley Arnold		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 and Calvin Thompson	SD	1979

1980

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

The Seedstock Breeder Honor Roll of Excellence

John Crowe	CA	1972
Dale H. Davis	MT	1972
Elliot Humphrey	AZ	1972
Jerry Moore	OH	1972
James D. Bennett	VA	1972
Harold A. Demorest	OH	1972
Marshall A. Mohler	IN	1972
Billy L. Easley	KY	1972
Messersmith Herefords	NE	1973

Robert Miller	MN	1973
James D. Hemmingsen	IA	1973
Clyde Barks	ND	1973
C. Scott Holden	MT	1973
William F. Borror	CA	1973
Raymond Meyer	SD	1973
Heathman Herefords	WA	1973
Albert West III	TX	1973
Mrs. R. W. Jones, Jr.	GA	1973
Carlton Corbin	OK	1973
Wilfred Dugan	MO	1974
Bert Sackman	ND	1974
Dover Sindelar	MT	1974
Jorgensen Brothers	SD	1974
J. David Nichols	IA	1974
Bobby Lawrence	GA	1974
Marvin Bohmont	NE	1974
Charles Descheemaeker	MT	1974
Bert Crane	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 Mitteness	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, Charolais	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 and Mary Shaw	ID	1977
Bob Sitz	MT	1977
Bill Wolfe	OR	1977
James Volz	MN	1977
A. L. Grau		1978
George Becker	ND	1978
Jack Delaney	MN	1978
L. C. Chestnut	WA	1978
James D. Bennett	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	1979
Del Krumwiede	ND	1979
Jim Wolf	NE	1979
Rex and Joann James	IA	1979
Leo Schuster Family	MN	1979
Bill Wolfe	OR	1979
Jack Ragsdale	KY	1979
Floyd Mette	MO	1979
Glenn and David Gibb	IL	1979
Peg Allen	MT	1979
Frank and Jim Willson	SD	1979

1980

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
Blythe Gardner	UT	1980
Richard McLaughlin	IL	1980
Charlie Richards	IA	1980

Continuing Service Awards

Clarence Burch	Oklahoma	1972
F. R. Carpenter	Colorado	1973
E. J. Warwick	ARS-USDA Wash.DC	1973
Robert de Baca	Iowa State Univ.	1973
Frank H. Baker	Okla. State Univ.	1974
D. D. Bennett	Oregon	1974
Richard Willham	Iowa State Univ.	1974
Larry V. Cundiff	RLHUSMARC	1975
Dixon D. Hubbard	USDA-FES, Wash.DC	1975
J. David Nichols	Iowa	1975
A. L. Eller, Jr.	VPI & SU	1976
Ray Meyer	South Dakota	1976
Don Vaniman	Montana	1977
Lloyd Schmitt	Montana	1977
Martin Jorgensen	South Dakota	1978
James S. Brinks	Colorado State Univ.	1978
Paul D. Miller	Am.Breeding Svc-Wis.	1978
C. K. Allen	Am. Angus Assn.	1979
Wm. Durfey	NAAB	1979
Glenn Butts	PRI	1980
Jim Gosey	Univ. of Nebraska	1980

Commercial Producer of the Year

Chan Cooper	MT	1972
Pat Wilson	FL	1973
Lloyd Nygard	ND	1974
Gene Gates	KS	1975
Ron Baker	OR	1976
Steve and Mary Garst	IA	1977
Mose Tucker	AL	1978
Bert Hawkins	OR	1979

1980

Jess Kilgore	MT	1980

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

1980

Bill Wolfe	OR	1980

Organizations of the Year

Beef Improvement Committee, Oregon Cattlemen's Assn.	1972
South Dakota Livestock Production Records Assn.	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 Assn. (BCIA)	1976
The American Angus Association (Breed)	1977
The Iowa Beef Improvement Association (BCIA)	1977
The American Hereford Association (Breed)	1978
Beef Performance Committee or Cattlemen's Assn.	1978
The Iowa Beef Improvement Association (BCIA)	1979

Pioneer Awards

Jay L. Lush	Iowa State University	Research	1973
John H. Knox	New Mexico State Univ.	Research	1973
Ray Woodward	American Breeders Svc.	Research	1974
Fred Willson	Montana State Univ.	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 Intl	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. Curtiss Mast	Virginia BCIA	Education	1976
Dr. H. H. Stonaker	Colorado State University	Research	1977
Ralph Bogart	Oregon State University	Research	1977
Henry Holzman	South Dakota State Univ.	Education	1977
Marvin Koger	University of Florida	Research	1977
John Lasley	University of Missouri	Research	1977
W. C. McCormick	Tifton, Georgia Test Stn.	Research	1977
Paul Orcutt	Montana Beef Perf. Assn.	Education	1977
J. P. Smith	Performance Registry Intl.	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.&Mrs. Carl Roubicek	University of Arizona	Research	1979
Joseph J. Urick	U.S. Range Livestock Experiment Station	Research	1979

1980

Byron L. Southwell	Georgia	Research	1980
Richard T. "Scotty" Clark	USDA	Research	1980
F. R. "Ferry" Carpenter	Colorado	Breeder	1980

1980 COMMERCIAL PRODUCER OF THE YEAR

Jess Kilgore of Three Forks, Montana, was named BIF Commercial Producer of the Year.

The operator of some 300 cows, Kilgore has increased weaning weights of his calves 156 pounds per head as a result of 20 years of dedication to performance selection. Kilgore started his herd in 1957. He has made steady progress in improving his herd through careful selection and the use of performance records, and has developed a national reputation for producing cattle with superior growth and carcass characteristics.

Kilgore was an early user of Simmental bulls and was one of the founding directors of the American Simmental Association, serving six years. He has been president of the Montana Beef Cattle Performance Association; a winner of the Ford Farm Efficiency Award; has been honored by the Federal Land Bank for outstanding contributions; served as the first president of the Northern Rocky Mountain Red Angus Association, and serves the National Cattlemen's Association on the Public Lands Council.

Jess Kilgore and his wife, Eloisa, have two daughters, who with their families are active in the day-to-day operation of the ranch.

1980 SEEDSTOCK PRODUCER OF THE YEAR

Bill Wolfe of Wallowa, Oregon, was named BIF Seedstock Producer of the Year.

The Wolfe herd was founded some 25 years ago on a foundation of two bulls selected from the C. K. Mousel herd of Cambridge, Nebraska, and has progressed to where it is one of the Polled Hereford breed's few herds to have bred and used three Superior Sires.

The Wolfe family operation, which includes five children, all of who are or have at one time or another been actively involved in the 650 cow operation, now has the sixth generation of Wolfe's, including Bill and wife Fern's grandchildren, in agriculture in the Wallowa Valley.

Wolfe is presently serving his second term on the board of directors of the American Polled Hereford Association; he has served as president of the National Western Polled Hereford Assication, the Columbia Polled Hereford Association, the Oregon Hereford Association and the Oregon Polled Hereford Association. A recognized judge of breeding cattle, Wolfe has been selected to make placing at fairs and shows in six states.

1980 CONTINUING SERVICE AWARDS

Glenn Butts was one of the founding fathers of the Beef Improvement Federation and has served on the BIF Board continuously since its inception as the representative of Performance Registry International. Few have been as faithful in their attendance of BIF meetings or as evangelical in promoting the concepts for which BIF stands. He is never afraid to speak out on an issue regardless how controversial. BIF is proud to honor Glenn Butts with a Continuing Service Award.

Jim Gosey has served BIF for several years as secretary for the central region. He did an outstanding job of planning and hosting the 1979 BIF annual convention in Lincoln, Nebraska. It is for this dedication and hard work that BIF honors Jim Gosey with this Continuing Service Award.

1980 PIONEER AWARDS

Byron L. Southwell, Tifton, Georgia, was honored by the Beef Improvement Federation for his efforts in pioneering beef cattle performance testing. Southwell was employed by the Georgia Coastal Plain Experiment Station in 1932 and began the station's livestock research program. Under his direction the Georgia Coastal Plain Experiment Station began conducting performance testing with a herd of Polled Hereford cattle in 1938. This was one of the oldest herds in the United States on which such records were kept. The success of this program can be documented by the bulls from this station that found their way into A.I. studs. Mr. Southwell was primarily responsible for developing interest which resulted in the construction of a beef performance test station located at the Experiment Station.

Mr. Southwell retired as department head in July 1967; however, he remains active in livestock circles, particularly with beef cattle.

Mr. Farrington R. Carpenter, a prominent Hereford Breeder from Hayden, Colorado, was cited by Beef Improvement Federation as a performance pioneer. Carpenter has been a champion of the cause of performance testing for over 40 years. He brought his first set of livestock scales in the 1930's and has been using them as a selection tool ever since. While commercial cattlemen have long recognized the value of Carpenter's "meat-type" Herefords, it has only been in the last decade that his cattle have received the notoriety due them among a large segment of the purebred industry.

Carpenter was one of the early members of Performance Registry International and over the years has been a strong supporter of the ideals and finances of that organization. In 1960 a prominent livestock editor in the midwest called him the "nation's top salesman" for the performance program.

In the late 60's when the performance movement started picking up steam but was still splintered, Farrie was one of the prime movers of the effort to coordinate the various programs through a single entity. It was this movement that eventually led to the formation of the Beef Improvement Federation.

Today, at a very young 93 years of age, Carpenter is still very active in the management of his ranch and is still looking toward the future.

Richard T. "Scotty" Clark, the first national coordinator of beef cattle breeding research, was honored posthumously by the Beef Improvement Federation for his work in the area of beef performance testing. Clark, through his aggressive leadership, helped to organize and develop the present Regional Beef Cattle Breeding Research projects. These projects have yielded much of the modern technology in animal breeding that has been so crucial to the entire beef performance testing movement.

Clark has had a lasting impact upon the industry through the research he supervised, by the guidance and inspiration he provided for young researchers in beef cattle breeding and by kindling an interest in performance testing among numerous seedstock producers. Among those individuals who were influenced profoundly by Dr. Clark were Drs. Robert Koch and Ray Woodward. Both were undergraduates at what was then Montana State College when Dr. Clark was serving as department head there. Dr. Koch gives Clark full credit for stimulating his interest in beef cattle breeding research which lead to his pursuing a graduate education. Dr. Woodward's feelings are typical of many of Dr. Clark's former students when he stated, "any success I may have had in beef cattle research is due in strong measure to his influence and guidance."

Among the many cattle breeders profoundly influenced by Dr. Clark were California's John and Mary Crowe and F. R. Carpenter of Hayden, Colorado. Although Dr. Clark passed away in 1965 his influence is still felt by those in the industry today.

ATTENDANCE - BEEF IMPROVEMENT FEDERATION CONFERENCE - 1980

Curtis W. Absher
USDA-SEA, Room 220
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Beltsville, MD 20705

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American Angus Assn.
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St. Joseph, MO 64485

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