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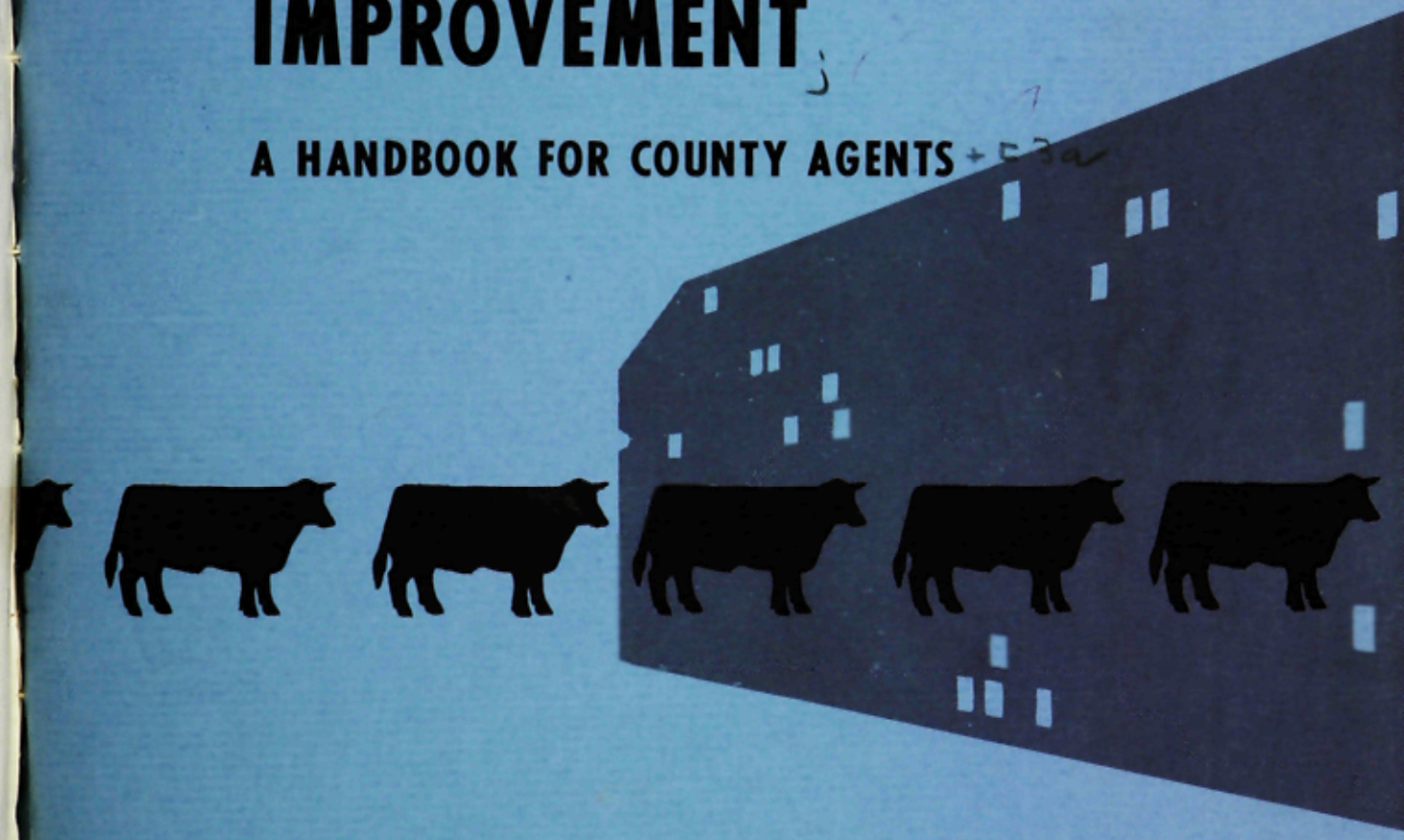
A HANDBOOK FOR COUNTY AGENTS



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BEEF CATTLE IMPROVEMENT

A HANDBOOK FOR COUNTY AGENTS

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INTRODUCTION

Beef cattle producers have long been important clients of the Cooperative Extension Service. Their problems concern Extension workers in most States. Production efficiency and/or productive resource utilization are important considerations in developing Extension programs in beef producing areas. Adjusting the quality and quantity of beef available to the consumer's needs is also important.

Beef cattle improvement programs have been designed by Extension workers and beef industry leaders to help producers recognize and select breeding stock that will improve their overall production efficiency and the market value of their animals. Performance testing is one major tool. It emphasizes the selection of breeding stock on the basis of records that indicate—

1. inherited defects;
2. fertility;
3. nursing ability;
4. growth rate;
5. feed efficiency;
6. carcass value;
7. soundness, style, and balance of conformation.

These beef cattle improvement programs must conform to overall Extension educational procedure as outlined in the following statement from "Cooperative Extension Service—Livestock Industry Relationships", approved by the Extension Committee on Organization and Policy in January 1963.

"The Extension educational procedure is a series of steps or events leading toward an end. It emphasizes assisting people through educational means to:

1. Analyze the situation and define problems confronting them.
2. Appraise alternative solutions to a particular problem and indicate probable consequences of each.
3. Provide information, through educational means, which will enable people to take action necessary to bring about the desired solutions.

"When the educational function has been effectively carried out, the people themselves will have recognized a problem as their problem, will have decided on what action they needed to take, if any, and will have been committed to taking this action.

"Cooperative efforts for exchange of information, development of procedures of policy, and more especially mutual assistance in all educational programs are needed between the Extension Service, State and Federal agencies, and beef industry firms or organizations.

"In conducting Extension educational work, Cooperative Extension workers shall not engage in commercial activities. In working with industry firms or organizations in various ways, Cooperative Extension workers shall perform educational work in such a manner that it will not be misconstrued as endorsement of the products or services of a particular business or group. As Extension cooperates with industry firms and organizations, the educational assistance shall be equally available to competing firms and organizations. The general policy of the Cooperative Extension Service, relating to commercial activities, is fully applicable to Cooperative Extension Service-Livestock Industry Relationships."

If an industry organization at either the State or national level involves Extension workers in a program of mutual interest, Extension's role must be clearly identified for and approved by the appropriate Extension administrator (State Director for State programs or Federal Administrator for interstate programs). By cooperating with industry, Extension gains extra chances for educational work. In planning these cooperative efforts, Extension workers must resist being projected into service work. When a program requires continuing "service work", they must plan to fund this "program phase" from money other than that appropriated for education.

YOUR ROLE IN THE COUNTY

County and area Extension workers must continue to play a key role in working with all groups concerned if the United States is to reach the volume of testing needed for genetic improvement in beef cattle. State Extension staffs and national registry organizations don't and probably won't have the personnel needed to carry on improvement programs without help.

The role you play will vary. The greater the local importance of beef cattle, the larger your role will be. For this discussion, assume that beef cattle, especially cow-calf operations, are major factors in the agricultural income of your area.

Your major role is to *create an awareness of the economic value of performance testing.* Sometimes county workers have initiated a beef improvement program without discussing the use and value of records. This can result in unsatisfied cooperators. *Breeders and producers should be fully aware of the value, need, and use of accurate performance records.*

Develop the program around an educational program, not a service program. At first, considerable time will be spent on the mechanics of testing. This naturally will include the weighing, grading, record forms, and computation procedures to be used. If you expand the performance program in your area, cooperators should be able to take care of the service details of the program after a reasonable orientation period. However, you should continue consultation and educational assistance.

Placing responsibility for the mechanics of herd performance testing on the breeder or producer frees you for other things. You have time to emphasize education and record evaluation. You can also work with new cooperators and increase the scope of your beef improvement program. *The often-heard complaint that there isn't enough time can be overcome if you develop your program to be educational, not service-oriented.*

The final factor in the success of the county beef improvement programs is record evaluation. A program is no better than the use made of performance records. Too often records are obtained but not used or fully understood. Work closely with your cooperators to see that all analyses and comparisons useful to them are made whether the records are manually or machine-computed. Never overlook the extreme importance of using records to select herd bulls. Much of this evaluation will have to be done individually, but small meetings of cooperators can be extremely useful.

Remember, the progress of a county program should be measured by the improvement made in the herds, not solely by the number of cooperators.

STATE LEADERSHIP

State specialists organize educational programs. With the help of other Extension workers and a state performance testing organization, they try to tell cattlemen of the opportunities performance testing offers.

The specialists are also responsible for developing the mechanics of the testing program. Where records are centrally processed, the specialist supervises record processing. Where central processing is not used, the specialist is responsible for developing uniform record processing techniques. This includes developing forms for herd enrollment, field records, and processing.

The specialists' most important job is teaching cattle breeders how to interpret records and apply the results. This phase is too often neglected in the maze of routine record processing and other educational duties. Publications, personal visits, training of county personnel, etc., should be used to get record results used in breeding programs.

Program operations can generally be supported by an energetic state performance testing organization. This organization should be the focus of cattle improvement interest, lead performance programs, and promote educational activities and improvement ideas.

To work best, the state organization must involve all segments of the industry. Having each breed and both purebred and commercial breeders represented will insure a successful operation. The representatives serve not only as directors of the state program but also as liaison with their own groups. Close cooperation between the state organization and breeder groups and organizations is vital to the program.

The state organization develops policies and outlines programs to carry out performance testing objectives. All phases of the program such as preweaning, postweaning, and carcass evaluation programs should be guided by this organization.

The specialist and/or other university staff members are technical advisors to the state organization and developers of testing methods and techniques. They are the voice of performance testing in their State.

DATA PROCESSING CENTERS

One of the marvels of the century is electronic data processing. This process has strengthened beef cattle improvement programs and eliminated thousands of hours of laborious hand work. It has permitted Extension specialists to use their technical training in counseling cattlemen rather than in being bogged down in data computation.

Working with a data processing center is similar whether the service is sponsored by the university or another organization. Knowing a computer's capabilities and capacities will keep you from becoming lax in your efforts to get exact detailed information. The computer can do only what it is "told to do." In other words, the raw data you send to a computing center must be exactly stated and coded in computer language. At the high cost of machine operation, you cannot afford a wrong date that would mean a costly rerun on 500–600 head of cattle. All of them would have to be recalculated on the basis of averages for the group, herd, breed, sex, feed practice, etc.

People are most important to a computation center. Usually none of the personnel, from executive to key-punch operator, knows livestock growth habits. At the very beginning Extension staff members, including secretarial staff, should meet with the "working staff" of the computing center to establish understanding of the Beef Cattle Improvement program and the operating procedures. Even minute details should be understood by everyone concerned. The computer center staff should know what raw data will be available and how it will be collected. The output data anticipated by the Extension staff should be described in detail.

Assume nothing. For example, don't neglect to give a full date such as February 17, 1965, as a birth date and assume the key-punch operator will know that this calf was born the same year that its record is processed. Neither the operator nor the machine knows this. Either the machine stops or you get a large error in average daily gain.

This means someone must pay for a rerun at several dollars per minute.

Program efficiency is usually improved when a competent member of the Extension staff (perhaps a graduate student or a well-trained secretary) checks the data sheets before and after processing. When raw data sheets are incomplete this staff can contact the breeder for additional information. Examining the sheets after computation can prevent the release of incorrect data. The release of miscalculated records discourages cooperators and is poor public relations.

Beef improvement program needs change and the methods must be revised if the educational needs of cooperators are to be met. This means changing adjustments, coding, etc., as resultant data demands. Be sure a change is right before making it. Changes mean more trips to the computer center, orientation procedures with all involved, and a total "debugging" before all systems are ironed out and running smoothly again.

The cost of machine operation makes it desirable and necessary to carefully examine all data requested. Only information of benefit to the program, the cooperators, and the overall improvement of cattle should be processed.

CENTRAL TESTING STATIONS

Good management, sound regulations, proper financing, and breeder interest are essential to successful central testing stations. Most test stations are organized or supported by State beef cattle improvement associations, although some are privately owned and operated. In either case, Extension workers gain extra teaching opportunities by working with test stations and their supporting organizations. Management and regulations are the two areas in which most cooperation will be needed. Sponsoring organizations often request official sanction (as an unbiased party) of weighing and reporting of results. Financing should be the responsibility of the sponsoring organization.

In the appendix, page 6, are procedures for measuring traits of economic value recommended as the basis for test station operation. Additional regulations and procedures will, of course, be necessary for each station. Sound rules and regulations are a must. However, they should not be too detailed or lengthy. A few sound rules are easier to enforce. The test supervisor (who may be a specialist or agent) should have authority to interpret and carry out regulations. A small appointed or elected test committee of three or four members can help make major decisions.

The educational value of central testing stations is of special significance in developing a beef cattle improvement program. Other purposes of the stations are discussed in detail in the appendix. You have a responsibility to use the educational value of test stations to the best advantage. Avoid being just a weighmaster. Use the test station to acquaint producers with the advantages of overall performance programs. Emphasize within-herd improvement. Breeders can use central testing stations to measure individual performance of single animals or to progeny-test a particular sire. If used as a progeny test, at least five offspring should be tested. In many cases a breeder will wish to collect data on all his bull calves, some at the test station and the rest at home. This is desirable but the breeder should also be encouraged to manage his bulls at home like those on test.

Testing programs should not be regarded as contests, but rather as a way to get information that will help breeders improve their herds. There will always be some within- and between-breed competition. If this can be kept friendly, the test station will be more successful and you will be held in higher esteem. Individual breeders will accomplish little by participating in bull tests unless they follow a complete testing program.

Testing will be most effective when all animals have the same chance to express their true genetic value. Remember that test gains are only part of total performance. Weaning weight and lifetime gain are two factors that should be included in reporting. Pretest environment may carry over into the test period. Suboptimum pretest environment, for example, may be followed by compensatory test gains that don't reflect the animal's true genetic ability. By considering and reporting weaning data and by averaging pretest and test data for lifetime gain, you can account for all phases of the animal's growth period. Pretest environment can also be minimized by accepting animals within narrow age ranges and as close to weaning as possible (see appendix). However, breeder variation in calving dates is common in most areas. A simple plan is to divide the test groups by ages. A maximum of 90 days per age group is a good idea; 60 days is even better. These might be referred to as junior and senior groups.

Refer to the appendix of this handbook for recommendations on pretest adjustment periods and test length. Since test rations are subject to controversy and available feed constituents will vary from area to area, no other suggestions are offered. However, the ration should be reasonably consistent from year to year.

In most tests a sale follows completion of the test. Sales should be handled by a committee of breeders with bulls on test. The testing organization should be responsible for the sale and financing, not you.

THE USE OF PERFORMANCE DATA

Counseling beef cattle breeders is one of your basic educational tools. Some of the most important counseling is done before a breeder weighs his first calf. The new breeder must have a complete understanding of what performance testing can and cannot do for him. He must understand that it can't replace good feeding and sound management

programs. He should *realize:* (1) It is only as accurate as the dates and measurements taken; (2) it is intended only to help select between cattle raised on a given farm or ranch under the same environment and management practices, and should not be used to compare cattle raised under other conditions; and (3) the results come not from getting the facts, but from using them in a sound selection and breeding system.

Encourage the breeder to keep a herd health book—not an elaborate book, but just the usual "snuff book" or "little black book" used to keep breeding dates, calving dates and other herd information. In this book, have him note each incident that might affect the performance of either the calf, cow, or sire. Many shifts in performance can be explained by pink eye, sore foot, calving problems, etc., in the cow herd, and by scours, pink eye, sore foot, injury, etc., in the calf crop. This "little black book" can be of untold value in selling an all practice performance testing program to a beef cattle producer. This is probably the first time he has seen how many things affect production. It brings home the old saying, "It's the little things that count."

Counseling breeders should not be a one-shot proposition. It is a continuous and very vital part of the program. The first and one of the most profitable counseling periods can be on a weigh day if you can be present. This is the ideal time to set the stage for future work. You and the breeder have your source of information fresh on your minds and still have a chance to take the important second look. At this time you can discuss overall production items such as calving percentages, average weight, average type score, general health and condition. Individual, group, and specific comparisons must wait on the processed records. While you're talking, make notes to use in evaluating the performance data.

The second counseling session should be by mail. Return record evaluations with the analyzed performance data. Use your notes to point out information that might slip by the less experienced eye of the breeder. Raise questions about points that should be discussed later.

Encourage and, if necessary, help the breeder organize his performance data so he can get the most use from it. Encourage him to develop and be familiar with the progeny records of each sire relative to the herd average. Complete up-to-date records make the data more meaningful and ease future counseling on the overall selection program.

Plan at least one yearly farm counseling session or a scheduled conference between the breeder and you or the livestock specialist to go over all the performance data and plan future herd improvement.

Use breed association meetings, conferences, field days, and mass media to teach the industry the value and potential of the beef cattle improvement programs. Encourage breeders to buy only animals with acceptable records of performance and encourage all purebred breeders to enroll their herds.

NATIONAL REGISTRY ASSOCIATION PROGRAMS

In most States, beef cattle improvement programs are part of Extension's work. State Beef Improvement Associations and national registry organizations cooperate in or sponsor beef cattle recordkeeping programs. All the various programs available to cattlemen are basically concerned with the same items of economic importance. A breeder who can remember all the details on reproductive efficiency, weaning weight, grade, growth rate, freedom from inherited defects, etc., for each of his animals may not need to keep records; however, according to the ancient Chinese, "Faintest record is better than fondest memory."

Recent industry trends suggest a need for more records. Breeders who choose to keep complete herd performance and production records soon realize that there are many ways a complete system can be developed. A complete herd record system includes: (1) Lifetime reproduction records on the cows (giving the number, quality, and weight of calves, and other pertinent information in relation to contemporaries); (2) preweaning growth record of all individual animals (giving weight, quality, and other important information); (3) postweaning growth record of all individual animals (i.e., yearling weight and quality score related to contemporaries); (4) a record of estimated carcass value (from slaughter data for some individuals, or from live animal appraisal with special instruments i.e., sonoray, photogrammetry, etc., on all individuals); and (5) lifetime progeny records of bulls, including performance of a male and female offspring (this should include carcass merit measurements).

A breeder can develop this complete herd record system on his own or in cooperation with a university-sponsored beef improvement program and/or a registry association-sponsored program, i.e., breed association or performance registry group. There is no one best record system for all cattlemen. Each must analyze the systems available and decide what is best for him. Thus, you must be prepared to work with cattlemen who use all types of recordkeeping systems. In each situation, you must comply with Extension policy on relationships with industry groups (see introduction).

A beef cattle breeder will be able to obtain a satisfactory record service by cooperating with the registry associations, with the Extension Service, or through his own private record program. The performance of the cattle will probably be measured essentially the same way in all of these systems. It is also likely that data collected will be expressed in essentially the same manner (see appendix). The groundwork has been laid for data exchange among these various recordkeeping systems. The breeders who own the cattle can write their own tickets in the use and exchange of records concerning their herds. For example, upon breeders' requests, Extension staffs often forward beef herd data to a registry association where it is recorded for the breeder. In most cases, there will be a recording charge. Similarly, the registry associations give the universities information for research and education. Information can also be exchanged among registry associations with permission from the breeders. The entire industry profits when public and private organizations cooperate and make maximum use of all data collected.

Extension workers at all levels should be prepared to work with all breeders who are participating in beef cattle improvement programs sponsored by either state or national groups. The primary objective of this Extension work is to help the individual breeder learn to make the most of the productive resources he controls. Plan your educational programs so this type of assistance is available to all beef cattle breeders.

APPENDIX

REPORT OF UNITED STATES BEEF CATTLE RECORDS COMMITTEE: RECOMMENDED PROCEDURES FOR MEASUREMENT OF TRAITS OF ECONOMIC VALUE

Participants in the development of the report and in committee activities were:

- American National Cattlemen's Association—Dudley Campbell, Secretary;
- Performance Registry International—John J. Heckman, Jr., Secretary, and Dale Lynch and Jerry Litton;
- American Angus Association—Glen Bratcher, Secretary, and Stanley Anderson;
- American Brahman Breeders' Association—Harry P. Gayden, Secretary;
- American Hereford Association—Paul Swaffar, Secretary;
- American International Charolais Association—J. Scott Henderson, Secretary;
- American Polled Hereford Association—Orville K. Sweet, Secretary;
- American Shorthorn Association—C. D. (Pete) Swaffar, Secretary;
- International Brangus Breeders' Association—Roy Lilly, Secretary, and Jesse Dowdy;
- Red Angus Association of America—Sybil Parker, Secretary, and C. T. Parker;
- Santa Gertrudis Breeders' International—R. P. Marshall, Secretary;
- Cooperative Extension Service—Frank H. Baker, Federal Extension Service; C. O. Schoonover, Wyoming; C. C. Mast, Virginia; Melvin Bradley, Missouri; and W. W. Wharton, Ohio;
- Agricultural Research Service—E. J. Warwick, Chief, Beef Cattle Branch, USDA; Keith E. Gregory, North Central Region Investigations Leader; R. S. Temple, Southern Region Investigations Leader; and J. S. Brinks, Western Region Investigations Leader.

Other organizations contributing ideas to this report are the American Meat Science Association, Extension Beef Improvement Subcommittee of the American Society of Animal Science, and the Livestock Division, Consumer and Marketing Service, USDA. No preference for (or discrimination against) any individual breed of cattle or organization listed above or not listed is intended by the Committee.

Introduction

The primary objective of this report is the achievement of greater uniformity of measurement procedures and methods of expression of measures of performance traits on beef cattle record of performance programs. It is not the intent of this report to recommend a standard program applicable to all segments of the beef cattle industry; however, uniformity of terminology and method of expression of measures of "key" performance traits is essential to rapid and accurate communication among individuals, organizations, and the basic segments of the beef cattle industry.

Performance or economic traits of beef cattle include those that contribute to both productive efficiency and desirability of product. The traits of economic value in beef cattle may be summarized by identifying the interests of the different segments of the industry. The commercial producer is interested in cows with long productive lives that wean a high percentage calf crop of heavy, high grading calves: the feeder expects rapid and efficient feed lot gains; and the packer and retailer are interested in the maximum amount of edible portion per unit of live and/or carcass weight. The consumer expects the edible portion to be tender, flavorful and juicy.

Fundamental to the genetic improvement of all traits of economic value in beef cattle is the measurement or evaluation of differences between animals. The preferred measurements are those that give the most accurate estimate of the breeding value or genetic merit of an animal relative to others in a herd. It is the function of records to increase a breeder's knowledge of differences between animals and thus increase the accuracy of his selections.

The systematic measurement of differences among animals in the traits of economic value, the recording of these measurements, and the use of the records in selection will increase the rate of genetic improvement in individual herds and thus in a breed and the total cattle population.

Differences between animals are due to two major causes, genetic and environmental. The observed or measured performance of each animal in each trait is the result of its heredity and the total environment in which it is raised. Adjustments can be made for known environmental effects such as age, age of dam, and sex. By adjusting for these effects, a breeder can rank individual animals more accurately on their estimated genetic worth for specific traits. In addition to the environmental effects for which adjustments can be made, there are many random or chance environmental variables which contribute to errors in estimating relative breeding values of animals based on their own performance. The importance of some of these, such as differences in fill at time of weighing can be appreciably reduced by following appropriate and uniform procedures. The weighing conditions should be the same for all animals that are to be compared. In central testing stations, it is recommended that initial and terminal weights be taken on 2 consecutive days following an overnight (12 hrs.) shrink without feed and water.

The rate of improvement in a herd, breed, and population is dependent on (1) the percentage of observed differences between animals that is due to heredity (heritability), (2) the difference between selected individuals and the average of the herd or group from which they come (selection differential), (3) the genetic association among the traits upon which selection is based (genetic correlations), and (4) the average age of parents when the offspring are born (generation interval).

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.

The principal features of effective record of performance programs are as follows:

1. All animals of a given sex and age are given equal opportunity through uniform feeding and management.
2. Systematic written records are kept of all traits of economic value on all animals.
3. Records are adjusted for known sources of variation, such as age of dam, age of calf, and sex.
4. Records are used in selecting replacements (bulls and heifers) and in culling poor producers.
5. Nutritional program and management practices are practical and compatible with those where progeny of the herd are expected to perform and are uniform for the entire herd.

Fertility and the various components which contribute to it have generally been found to be low in heritability on a within-breed basis. For this reason, it does not seem wise to give it major emphasis even though fertility is the single most important economic factor in beef cow herd production. Because of a possibility that low fertility or sterility may be more highly heritable than above-average fertility, it is recommended, however, that complete calving records be

maintained on all cows in breeding herds and that records on fertility of bulls be maintained. Prospective herd sires should not be saved from either sires or dams of subnormal fertility. Replacement heifers should be saved from such animals only if they are truly superior in other respects.

How To Handle Records According to Sex of Animal and in Relation to Contemporary Animals

Records of growth of individual animals (both pre- and post-weaning) should be reported and/or published on the basis of each sex (within sex basis without sex adjustments). In the case of sire, dam, and group summaries where data are adjusted to a common sex, the particular common sex used should be the option of the organization sponsoring the program. However, the common sex (bull or steer) used in the adjustments should be clearly stated in all reports. If it should be desirable to convert 205 day weight summaries from one common sex to another, calculations should be based on a 10-percent difference between bulls and heifers (with steers being 5 percent less than bulls and 5 percent greater than heifers).

It is further recommended that for sire, dam and group summaries all associations and organizations use weight ratios computed on a within sex basis for

(1) *adjusted 205 day weight (weaning) and*
(2) *adjusted 365 day weight (yearling) and 550 day weight (long yearling).*

In dealing with records for herds in which numbers are small, weight ratios should be computed after the conversion of data to a common sex basis.

Weight ratios within sex groups are calculated by dividing each individual's weight adjusted for age and for age of dam by the average of its sex group and expressing it as a percent of its sex group average. Sire, dam, and group summaries are made by averaging the weight ratios of the animals involved.

Weight ratios should also be reported for individual animals to provide for ease of ranking individuals of each sex in making selections.

Measurement of Weaning Weight (205 Days)

Weaning weights are measured to evaluate differences in mothering ability of cows and differences in growth potential of calves. For best estimates of genetic worth for weaning weight, it is necessary to adjust individual calf records to a standard basis. It is recommended that the standard basis be to 205 days of age with a mature equivalent dam. The objective of such adjustments is to arrive at the best estimate of what a calf of a particular sex would have weighed at 205 days of age if its dam had been mature. It is also recommended that weights be recorded when the calves are between 160 and 250 days of age.

It is suggested that 205 day weights be computed on the basis of average daily gains from birth to weaning. This is accomplished by subtracting a constant of 70 pounds (or actual birth weight, if available) for birth weight from actual weight, dividing by the age in days at weaning, to obtain average daily gain, and multiplying the average daily gain by 205 and adding the 70 pounds that was subtracted initially for birth weight (or actual birth weight). This provides 205 day weight, unadjusted for age of dam and sex of calf. This procedure is summarized by the following formula:

$$\text{Unadj. 205 day weight (lbs.)} = \frac{\text{actual wt.} - 70}{\text{age in days}} \times 205 + 70.$$

To adjust for age of dam, the following adjustment factors are recommended.

Age of dam—

- 2 year olds—multiply computed 205 day wt. by 1.15
- 3 year olds—multiply computed 205 day wt. by 1.10
- 4 year olds—multiply computed 205 day wt. by 1.05
- 5 through 10 year olds—no adjustment
- 11 year olds and up—multiply computed 205 day wt. by 1.05

For selection purposes weaning weight should probably be considered in relation to weight of dam. However, because of differences in condition, meaningful cow weights are so difficult to determine that it seems impractical to include this as a recommendation in record of performance programs at this time.

Weaning weight ratios (computed as previously stated) of individual and for sire, dam, and group averages should be reported and used in comparisons.

Measurement of Yearling Weight (365 Days) or Long Yearling Weight (550 Days)

Yearling weight at 365 days or long yearling weight at 550 days are particularly important parts of record of performance programs. It is suggested that yearling weight be computed *separately for each sex.* When 365 day weights are used, it is recommended that they be computed on the basis of average daily gain of each animal in a time constant post-weaning feeding or grazing period of at least 160 days immediately after weaning.

The postweaning period should start on the date weaning weights are obtained (i.e., actual weaning weight is used as initial weight on test). Research results show that the age of dam effects on 365 day weight are of approximately the same magnitude as age of dam effects at weaning. For this reason, it is desirable to add postweaning gains in a 160 day postwean-

ing period to weaning weight adjusted for age of dam to arrive at adjusted 365 day weight. The following formula is appropriate for computing adjusted 365 day weight:

$$\text{Adj. 365 day wt.} = \frac{\text{actual final wt.—actual wn. wt.}}{\text{number days between weights}} \times 160 + \text{wn. wt. (205 days) adj. for age of dam}$$

The period between weaning and final weight should be at least 160 days and final weight should not be taken at less than 350 days of age. It is recommended that the number of days between weaning and final weight be the same for all animals of the same sex in a herd. By use of this procedure, it is necessary to obtain only weaning weight and yearling weight on each animal. Also, all periods in an animal's life are accounted for, i.e., no "loafing" periods.

The procedure of using adjusted 365 day weights as a measure of yearling weight will apply primarily to herds that develop bulls on a rather high level of concentrate feeding starting at weaning time. For herds that prefer to develop bulls more slowly, and with the lower level of feeding more generally practical and applicable for growing out potential replacement heifers, a long yearling weight is suggested as an alternative to adjusted 365 day weights. This is accomplished by measuring growth rate in a period of approximately 345 days postweaning with weaning weight and date being initial weight and date of postweaning period.

Adjusted long yearling weight (550 days) for each sex should be computed in the same manner as adjusted 365 day weight. Thus, the appropriate formula for computing adjusted 550 day weight would be:

$$\text{Adj. 550 day wt.} = \frac{\text{actual final weight} - \text{actual wn. wt.}}{\text{number days between weights}} \times 345 + \text{wn. wt. (205 days) adj. for age of dam}$$

Yearling weight rations (computed as stated on p. 8) of individual animals and for sire, dam, and group averages should be reported and used in comparisons.

Central Testing Stations

Central testing stations are locations where animals are assembled from several herds to evaluate differences in some performance traits under uniform conditions. Present and potential uses of central testing stations include: (1) Determining the gaining ability and conformation scores of potential seed-stock herd sires as compared to similar animals from other herds; (2) determining the gaining ability and conformation scores under comparable conditions of bulls being readied for sale to commercial producers; (3) finishing steers or heifers scheduled for slaughter as part of progeny test programs for growth and carcass traits; (4) as an educational tool to acquaint breeders with record of performance; and (5) estimating genetic differences between herds or between sire progenies in gaining ability, conformation, and carcass characteristics.

It is important that the objectives of a central testing station be clearly defined and procedures designed to accomplish the objectives. Since specific objectives and procedures may vary with location, only general principles will be discussed here.

In beef cattle, nutritional level at one stage of life usually has carryover effects on performance at later stages. A poor feed supply in one period tends to be followed by a period of increased or "compensatory" gain when rations are increased. Conversely, a higher than normal level of feeding will likely be followed by a period of subnormal gains on a normal feeding regime. Following a compensatory period, good performance tends to be related to good early performance and vice versa.

Since pretest levels of nutrition and management usually differ from farm to farm or ranch to ranch, performance at a central test station may be influenced by pretest environment. From one standpoint, this is a serious disadvantage of central test stations since part of the observed differences in performance at a station will be due to pretest conditions. It will nearly always be impossible to estimate the importance of these effects. However, carryover herd environmental effects will be less important than herd differences due to environment had all animals been fed for a comparable period in the herds in which they were produced. From this standpoint, central testing stations minimize herd environmental effects.

Bull buyers have to decide on (1) which herds to buy bulls from and (2) which bull or bulls to buy within a herd. If the bulls are raised and fed entirely on the farm or ranch where dropped, the buyer has the nearly impossible task of deciding how much of the apparent superiority or inferiority of bulls in a specific herd is due to feeding and herdsmanship. Having them handled for part of their lives under standard conditions minimizes these effects and makes the task of the buyer easier, whether he is buying commercial bulls or herd sires for a purebred herd.

Similarly, if progeny test groups of steers from different herds are being fed out to determine the transmitting ability of the sires for growth rate, efficiency, and carcass traits, sire comparisons are more accurate if all progeny are fed under standard conditions for the final feeding period.

Central tests are of limited usefulness for estimating genetic differences between herds. If used, at least 5 to 10 head per herd should be tested annually for a

minimum of 3 years. The larger the herd size, the greater the number will need to be to adequately sample the herd. The precision of the tests may be improved if five to eight progeny of each of two or more sires from each herd are tested each year. This permits assessment of within-herd differences to compare with between-herd differences. Further, efforts should be made to get a representative sample of animals from each herd on test or little real information on herd differences will be accumulated. If central testing stations are used to estimate genetic differences between herds, it is recommended that samples of those completing the evaluation be used in top-cross comparisons in commercial herds so that additional traits can be measured and the precision can be increased.

If the purpose is to evaluate individual potential sires, the number tested per herd or per sire is of no importance; but everyone concerned with the test should make a special effort to discourage between-herd comparisons if numbers from each herd are small. Preferably, bulls should be entered in this type of test only if they meet rigid qualifications for preweaning rate of gain, soundness, and conformation score.

If the purpose is solely to develop bulls and make objective performance information available to prospective buyers, the number of bulls per herd or per sire is immaterial. To be most useful, however, large numbers should be fed at a single location so buyers will have an adequate number from which to choose. Tests of this kind would be most useful as a service to small breeders, and if commercial-type feedlots were used, large numbers could be fed.

Influences of pretest environment on test performance can probably never be eliminated but they can be minimized by the following procedures:

1. Accept animals for test only within relatively narrow age ranges, preferably at or within one month after weaning. Accept no animal over 305 days of age at delivery. It would be desirable to have available pretest environmental information such as creep fed, pastured, condition score, etc.
2. Receive animals in relatively narrow time periods and consider the period after delivery to be an adjustment period. The adjustment period could be used to get cattle on feed and should be a minimum of 21 days prior to initiation of official test.
3. For initial weights on test and final weights off test use the average of two weights taken on successive days after minimum of 12 hours off feed and water before each weight.
4. Test rations that contain 60–70 percent concentrate and 30–40 percent roughage are adequate for most conditions under which bulls are tested.
5. The customary 140–150 days on full feed should be adequate on the foregoing concentrate rations under these conditions.
6. Growth data reported in central testing station results should include (1) adjusted weaning weight at 205 days (with weaning weight ratio) (2) daily gain on test (with gain ratio) (3) adjusted 365 day weight adjusted by the same procedure presented in the section of this report on measurement of yearling weight (with 365 day weight ratio) (4) actual weight per day of age at the end of the test.

Central test stations will be of greatest educational value if all concerned recognize that only a limited number of traits can be evaluated in them and that at best they are merely one phase of a complete performance evaluation program. One of the primary measures of the effectiveness of central test stations should be the impact they have for increased complete herd testing for all economically important traits. Choices between herds are likely to be made on the basis of many bits of information of which results from central testing stations may be one.

Conformation Evaluation

Record of performance programs should include traits that contribute to both efficiency of production and desirability of product. The items of conformation which should be included in a record of performance program are those traits that contribute to carcass desirability (thickness of natural fleshing or muscling) and the structural soundness that may contribute to longevity. Thus, conformation is important from the standpoint of both desirability of product and productive efficiency. The items of conformation that are important from the standpoint of carcass desirability are thickness of natural fleshing or muscling, particularly in the regions that produce the cuts of greatest value (back, loin, rump, and round) and the amount of outside fat relative to muscular development. The items of skeletal structure that may contribute to longevity pertain to the correctness of the basic architecture of an animal, i.e., back, neck, rump, pins, legs, and feet.

All animals should be evaluated for conformation when weaning weights and yearling weights are taken. The major items of conformation probably can be appraised more critically at the time yearling weights are taken.

In summary, the primary criteria in conformation evaluation should be (1) structural soundness which may be indicative of longevity, (2) thickness of natural fleshing or muscling, and (3) thickness of outside fat. Each of these items can probably be appraised more

critically in yearlings than in calves. Differences in thickness of muscling or natural fleshing can be appraised best by close observation of the areas where the least amount of outside fat is normally present. These areas are the outside of the round or quarter and the forearm.

Outside fat is a major factor in reducing yield of trimmed retail cuts. Outside fat in excess of one-fourth to one-half inch is trimmed off the retail cuts, and thus is undesirable. Indicators of outside fat are fullness of brisket and flanks as well as evidence of patchiness around the tail head and over the loin.

It is well to remember that bulls of yearling age have approximately 0.2 to 0.3 inch less outside fat than steers when both are developed on a full feed of a high concentrate ration. This difference should be considered when evaluating bulls. Thus, bulls carrying an amount of fat less than that considered optimum for steers are more desirable. Even though the fattest bulls may not be excessively fat themselves they may sire overfat steers.

Size or weight is a measure of growth rate and should not be considered in evaluating conformation.

A scoring system for conformation may be simple or it may be complex. A simple system should group animals of approximately equal desirability from a conformation standpoint; whereas, a more complex system should include independent scores for each of the major items of conformation.

The following simple scoring procedure (with description) is recommended for general use in Record of Performance Programs.

Conformation Score	*Description of Breeding Cattle*
17–16–15	Cattle eligible to receive these scores have no more than minor faults in any of the major items of conformation. Cattle in this category are basically correct in their skeletal and muscular structure, are outstanding in muscular development, and have optimum outside fat considering the manner in which they have been developed. Beef character in abundance describes cattle in this series. The top end of this series describes beef cattle of basically ideal conformation. Bulls in this series are strictly herd bull prospects from a conformation standpoint and females eligible for these scores possess the conformation desired for outstanding herd replacements.
14–13–12	Cattle eligible to receive these scores have no more than moderate faults in their muscular and skeletal structure. Their muscular development is usually less than outstanding but is average to superior. Skeletal structure is basically sound. Cattle in this category should include a relatively high percentage of the animals in the better purebred herds. The top end of this series represents the lowest end of herd bull prospects and the top end of commercial bulls from a conformation standpoint. The top end of this series describes superior female replacements for purebred herds, the middle of this series describes good female replacements, while the bottom end describes the females that are no more than satisfactory as replacements in purebred herds. The score of 14 describes superior commercial bulls; 13 describes good commercial bulls; and 12 describes satisfactory commercial bulls from a conformation standpoint. The top end of this series represents the practical top of commercial cattle. The lower end of this series includes a reasonably high percentage of the better commercial replacements.
11–10–9	Cattle in this category may have moderate to severe faults in some items of skeletal and muscular structure. Muscular development is usually average to inferior. Females in this category should be sound enough in their skeletal structure to perform their function. A high percentage of the female replacements from average commercial herds would be in the middle and top scores of this series. The lowest score in this series describes poor female replacements for commercial herds.
8–7–6	Cattle in this category are usually decidedly lacking in beef character, may have serious structural defects and may be definitely lacking in muscling. Represented here are the extreme bottom end of beef cattle.
5–4–3	Extremely thinly fleshed cattle. Represented here are the thinnest fleshed of dairy cattle.

Carcass Evaluation

The basic intent of carcass evaluation is to provide as much information as possible about the carcass. Two basic factors determine carcass merit—the proportion of the carcass that is edible and the indicators of quality and palatability of the edible portion.

The interpretation and use of carcass evaluation in breeding and management programs is subject to variability—variability dictated by diversification and changing market demands.

Following are objective and subjective measurement techniques used singly or in combination as indicators of carcass merit:

1. Hot carcass weight minus 2-percent shrink.
2. *Longissimus dorsi* area at the 12th rib.
3. Fat thickness of the 12th rib at a point three-quarters of the length of the *longissimus dorsi* from the chine bone end.
4. Estimated percent kidney, pelvic, and heart fat.
5. Percent trimmed *bone-in* retail cuts from the round, loin, rib, and chuck determined by actual cut-out.
6. Percent trimmed *boneless* retail cuts from the round, loin, rib, and chuck determined by actual cut-out.
7. Trimmed round.
8. USDA quality grade to one-third of a grade and desirably separate scores for marbling and the other components of the grade:
   (a) marbling
   (b) texture of lean
   (c) color of lean
   (d) firmness of lean
   (e) maturity
   (f) texture of marbling
9. Warner-Bratzler shear for estimating tenderness.
10. Taste panel for estimating tenderness and other characteristics affecting consumer appeal.

There are several methods of evaluating the beef carcass. Some of these can be accomplished on the ribbed carcass while others require further physical modification of the carcass. This is true of both quantity and quality measures. The degree of carcass modification necessary is often a factor which significantly influences the selection of the procedures to be used in a carcass evaluation program. For this reason the procedures have been grouped on the basis of various degrees of carcass modification. Thus, in planning an evaluation program, a breeder or organization should choose those phases which can be accomplished in a particular setting.

Phase one: Procedures that will estimate quantity and quality without physical change to the carcass.

USDA Formula for estimating percent trimmed boneless retail cuts from round, loin, rib, and chuck:

1. Carcass weight.
2. *Longissimus dorsi* area at the 12th rib.
3. Fat thickness at the 12th rib at a point three-quarters of the length of the *longissimus dorsi* from the chine bone end.
4. Estimated percent kidney, pelvic, and heart fat.
5. *USDA quality grade to one-third of a grade and desirably separate scores for marbling and the other components of the grade:*
   (a) marbling score
   (b) texture of lean
   (c) color of lean
   (d) firmness of lean
   (e) maturity

The first four items can be used in the following prediction equation to estimate percent trimmed boneless retail cuts from the round, loin, rib, and chuck (cutability):

Cutability = 51.34 − 5.784 (single thickness of fat over *longissimus dorsi* in inches) − 0.462 (estimated percent kidney, pelvic, and heart fat) + 0.740 (area *longissimus dorsi* in square inches) − 0.0093 (carcass weight in pounds).

Phase two: Procedures that require breaking the carcass permitting the use of more refined evaluation methods.

Section A: Percent trimmed *bone-in* retail cuts from the round, loin, rib, and chuck determined by actual cut-off.

Section B: Percent trimmed *boneless* retail cuts from the round, loin, rib, and chuck determined by actual cut-out.

Section C: *Wisconsin formula for estimating percent "retail yield" of trimmed bone-in retail cuts from the round, loin, rib, and chuck.*

1. Trimmed round.
2. Single fat thickness in inches over the rib-eye.

An estimate of retail yield can be calculated by the following regression equation:

Retail yield = 16.64 + 1.67 (percent trimmed round) − 4.94 (single fat thickness in inches over rib-eye).

This formula is recommended only for steer carcasses of the beef breeds that range in outside fat (3d measure) from 0.35 to 1.5 inches.

Section D: Quality grade as described in phase 1, item 5.

Phase three: Objective and subjective measures of quality in cooked retail cuts from a carcass.

1. Warner-Bratzler shear.
2. Taste panel.

The above phases are stated as briefly as possible. It is suggested that the acceptance of any of the above be on the assumption that detailed instruction be obtained on acceptable methods of collecting the data from the American Meat Science Association or the organization conducting the programs.

General Considerations in Progeny Testing for Carcass Merit

The primary purpose of a progeny test is to determine which of two or more bulls should be retained for extensive use in a seed-stock herd on the basis of results of progeny test.

Sire evaluation is currently a primary motivating force for the collection of carcass data. Thus, it is necessary to make some basic recommendations as to number of progeny per sire to be tested and other management factors. Since expense of testing dictates that only a limited number of bulls can be progeny tested for carcass characteristics and since most of the other characters in which we are interested are relatively high in heritability, only bulls which are outstanding in other characteristics and from dams of outstandingly good maternal qualities should be progeny tested.

Although each progeny evaluated in the carcass adds to the information about the transmitting ability of the sire being tested, it appears that 8 to 12 give a reasonably good evaluation of the transmitting ability of a sire. Thus, when the question becomes one of getting more progeny than this per sire versus progeny testing additional sires, it is recommended that additional sires be tested. Further, it might be pointed out that if 8 to 12 progeny are not available, as few as 5 to 6 will give indications about the probable transmitting ability of the sire.

If bulls are progeny tested for carcass traits, it is important that the tests be designed so that fair comparisons can be made on the relative genetic merit of the bulls used in the progeny test for the traits on which they are being evaluated. Thus, bulls to be compared should be bred to random samples of cows, with the calves born at approximately the same time of the year, reared under comparable conditions with uniformity of procedures in obtaining the appropriate carcass data.

It is desirable that all of the offspring on which carcass data are obtained be unselected and preferably of the same sex. If they are not all of the same sex, the proportion of sexes should be equalized insofar as possible and sex differences taken into account in evaluating a sire among the various sire progeny groups to be compared.

It is suggested that calves on which carcass data are obtained be fed for a time constant period immediately after weaning. The length of this period should be constant for all animals within a group but could be any length between 200–250 days.

An alternate procedure would be to feed to a weight constant end point. If this procedure is used, it is recommended that the animals be put on feed at weaning and that heifers be fed a finishing ration until they are in the 800–850 pound weight range, and steers be fed a finishing ration until they are in a 975–1025 pound weight range.

Calculation of "Estimated Carcass Value"

Since quality of the meat and the percentage of edible portion both affect the value of a carcass, it is desirable that both receive consideration. For comparing the progeny of different sires for carcass value, breeders may desire to combine these two basic items into a single expression—"Estimated Carcass Value". Such an estimate can be computed if the relative values of cutability (estimated yield of boneless, closely trimmed retail cuts from round, loin, rib, and chuck) and quality grade are known. While the relative values of cutability and quality grade may be expected to vary somewhat throughout a year or over a period of years, because of changes in supply-demand patterns, the average relative importance of the two components over a period of time should reflect their most meaningful relationship with which the industry should be concerned. Averages for recent years have indicated that a 2-percent change in cutability has approximately the same effect on value as a change of one full quality grade by USDA standards.

Assuming that a 2-percent change in cutability (USDA Formula) has approximately the same value as one full quality grade, the following expression may be used to combine cutability and quality grade into "Estimated Carcass Value":

E.C.V. = Cutability (percent) + 0.7 × Quality Grade, coded with one unit of quality grade equal to one-third of a grade.

Carcass quality grade must be coded to a numerical scale for computing an "Estimated Carcass Value". Any descending code scale for quality grade may be used provided one unit change is equated to one-third of a grade. Thus, 17, 16, and 15 may be used for high, average, and low prime, respectively, with a comparable descending scale for the lower grades.

Differences in "Estimated Carcass Value" should reflect differences in actual carcass values provided both

differences in cutability and carcass grade are weighted according to their relative economic values.

Trends in supply-demand patterns should be evaluated continuously in regard to their effects on cutability-quality value relationships. Changes in value relationship should be reflected by changes in the "Estimated Carcass Value."

Carcass weight per day of age is used as a component of some carcass evaluation programs. Within groups of animals of approximately the same age raised and managed similarly, it is a simple and reasonably effective procedure.

Growth rate may be included in the computation of "Estimated Carcass Value" by adjusting the carcass weight for differences in age. Live weight adjusted for differences in age and multiplied by dressing percent provides an estimate of carcass weight on an age constant basis. Carcass weight (adjusted for age) multiplied by the "Estimated Carcass Value" will provide an estimate of value worth including growth rate, cutability, and quality of meat. The basis for this approach is that E.C.V. estimates value per pound of carcass including quality of the meat (carcass grade) and edible portion (cutability). Carcass weight (adjusted for age) is measure of growth rate. Carcass weight adjusted for age multiplied by estimated value per pound provides an estimate of merit that may be used for comparative purposes. This may be expressed as a ratio of group average by dividing the value (merit) for each individual into the group average. These procedures for combining growth rate with estimates of carcass composition (cutability) and meat quality are recommended because these components contribute to achievement of basic goals in the beef industry, i.e., efficient production of a high quality product.

General Considerations in Implementation of Carcass Evaluation Programs

The success of any carcass evaluation program is dependent on implementation; several problems are presented.

1. Identification.
2. Packer cooperation.
3. Actual data collection.
4. Transmittal of collected data to proper authorities.
5. Payment for data collection.

A method of obtaining data that has wide applicability is the use of the personnel of the Federal Grading Service in collecting data. This will provide the information consistent with phase 1 of the Carcass Evaluation Section of this report. Steps to follow in procuring this service are:

1. Arrange to have cattle slaughtered in a federally inspected packing plant or a nonfederally inspected plant approved to receive the Federal meat grading service.
2. Obtain packer permission to have carcasses evaluated by USDA meat grader.
3. Contact USDA meat grading office to make arrangements for Carcass Evaluation Service and to obtain tags for identification of cattle. (Cost of service is based on $7.40 per hour of grader's time plus a 20-cent-per-head charge for transfer of identity tags by meat inspectors.)

Direct requests for the Beef Carcass Evaluation Service or additional information concerning it to: Meat Grading Branch, Livestock Division, Consumer and Marketing Service, U.S. Department of Agriculture, at one of the following addresses:

Atlanta, Ga. 30323— 50 Seventh Street NE., Room 245

Denver, Colo. 80216—403 Livestock Exchange Building

Bell (Los Angeles), Calif. 90201—5555 Eastern Avenue, Building 6, Section C

Baltimore, Md. 21223—Livestock Exchange Building, Room 3

Des Moines, Iowa 50309—Iowa Building, Room 205

San Francisco, Calif. 94111—630 Sansome Street, Room 717

Chicago, Ill. 60609—Livestock Exchange Building, Room 522

Forth Worth, Tex. 76106—233 Livestock Exchange Building

New York, N.Y. 10013—346 Broadway, Room 619

Cleveland, Ohio 44102—Livestock Exchange Building, Room 23

Kansas City, Mo. 64102—760 Livestock Exchange Building

Omaha, Nebr. 68107—609 Livestock Exchange Building

National Stock Yards, Ill. 62071—Post Office Box 187, 27 Livestock Exchange Building

Seattle, Wash. 98104—605 Federal Office Building

Sioux City, Iowa 51107—225 Livestock Exchange Building

South St. Paul, Minn. 55076—201 Federal Building

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