Rick Bourdon, a Red Angus breeder currently involved in teaching and research at CSU, has designed this series (continued from last month's Journal) to help breeders understand and use available performance information.

A Series
Beef Cattle Breeding

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Part Ten
Weighing the Traits—What Is the Best Animal?

The first nine articles in this series dealt almost exclusively with how we measure animals. Topics discussed ranged from weaning weight adjustments to the latest sire evaluation models. Measurement is a very important part of animal breeding; the better our measuring ability, the faster we can make genetic change. There is, however, an even more fundamental issue in animal breeding than the issue of measurement. That is the issue of selection priorities. What traits should we measure in the first place? And having taken the measurements, how should we apply them in a selection program?

Questions concerning measurement are mostly of a technical/academic nature, and are, therefore, relatively uncontroversial. Questions about selection priorities, however, have received proportionately little objective, scientific attention, and are highly controversial. What constitutes "best" is the subject of auction block rhetoric, promotional hyperbole and never-ending debate wherever cattle breeders gather. The subjective nature of the issue does not make it any less important, however. While our ability to measure allows us to make genetic *change,* only wise use of the measures we have will result in genetic *improvement.*

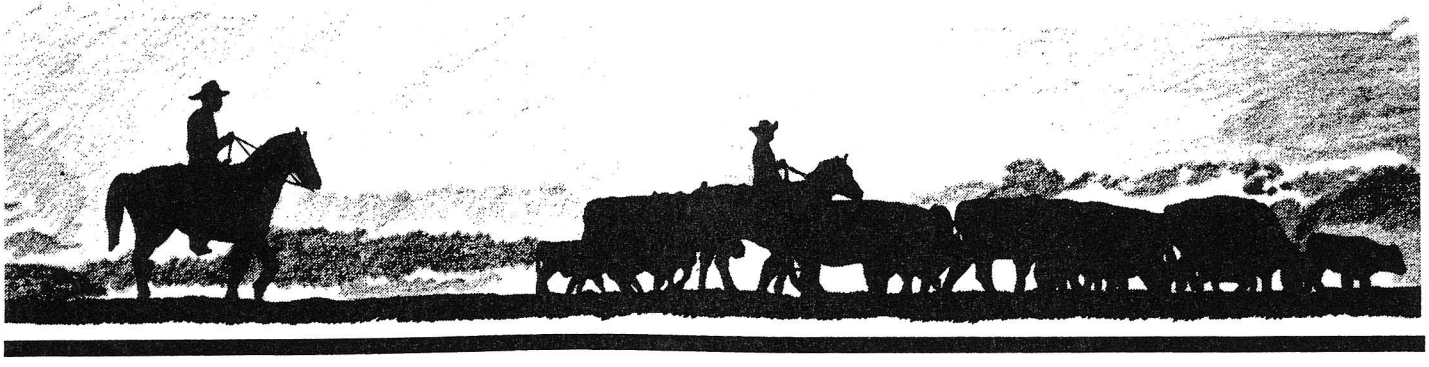
How, then, does a breeder decide what is the optimal combination of traits in a beef animal? Clearly, the answer depends on the breeder's perspective, which in turn depends on his goals. Here are some possible goals for a breeder of seed stock:

- to produce cattle which return the most dollars to their breeder.
- to produce show winners or cattle fancy enough to compete with show cattle visually.
- to produce central test toppers and sire evaluation trait leaders.
- to produce functional cattle—cattle that can survive the worst nature has to offer.
- to produce cattle that will be the most useful to the commercial cattleman.

It is the incompatibility of goals which makes decisions about selection priorities difficult.

If we are honest with ourselves, we will probably admit that our own goals encompass several of these to varying degrees. That is only natural. All are legitimate goals; no one goal can rightfully claim *moral* superiority over any other. Not all these goals are totally compatible, however. For example, the goal of producing cattle which return the most profit to the seed stock breeder may be at odds with the goal of producing the most useful cattle for the commercial man. Satisfying the first goal may dictate following purebred trends which have little value from a commercial standpoint. It is the incompatibility of goals which makes decisions about selection priorities difficult.

To make things easier, let's assume our sole goal is the last one listed: to produce cattle that will be the most



useful to the commercial cattleman, cattle that will return him the most profit, satisfaction or both. Certainly this is an unselfish goal. It relates not so much to personal gain as to the well-being of the commercial beef industry and to beef production efficiency. I personally feel this ought to be the goal of seed stock producers, knowing full well that it can't be exclusively.

How does one determine the most appropriate animal for the commercial cattleman? First, take a close look at the commercial operation. Examine it from a "systems" perspective, which is to say look at it in its entirety. A commercial cattle operation can be viewed as a system of component parts which are highly interdependent. The components can be divided into general categories: 1) natural environment, 2) economics (costs and prices), 3) cattle type, 4) mating system (straightbreeding, crossbreeding, etc.), and 5) management policies (everything else). Now decide what kind of cattle, within the limits of your breed, best fit into this system. This is no easy task. Many of the conclusions to follow are the results of a new methodology in animal breeding called systems analysis, a way of solving problems using sophisticated computer models.

Let's examine the components of the commercial cattle operation in more detail.

Natural environment

Unlike many species of domestic livestock, beef cattle must exist in a nearly natural environment. They must be able to survive and thrive in climatic and feed conditions over which man has little or no control. As a general rule, the production potential of cattle should be in balance with the forage resource. More productive cattle—those with greater mature size, growth potential or milk production—can often be more profitable, but they also have greater feed requirements. If the environment is not capable of meeting those requirements (in other words if feed availability is so restricted that a more productive type of cow cannot locate enough feed in the time she has available for grazing), then such cows can be considered too productive for the environment. Shortcomings will show up in lower conception rates and smaller calf crops.

It is difficult to say just how much productivity is appropriate for a given situation. To take some extreme examples, however, desert cattle should be below average in size and milk pro-

duction, while corn belt cattle should be above average in these traits. In evaluating an environment, an important thing to remember is that the environment we want to examine is not that of seed stock, but of commercial cattle. Because of their increased value, seed stock often receives special treatment. The rough edges of their environment may be smoothed somewhat by management. If a seed stock breeder wants first-hand experience with the environment of commercial cattle, he should treat his own cattle as commercial cattle are treated.

Another thing to remember when rating environments is that the forage resource cannot be evaluated by simply using *average* values; *consistency* of forage production must also be considered. If forage quantity and quality are very poor for two months of the year, but excellent during the remaining ten months, then the overall nutritional environment should still be rated poor. The same goes for an environment which is very productive in most years, but is highly susceptible to drought or severe winters and springs.

Variability of natural environment forces us to consider risk when deciding the proper level of productivity for a particular locale. In general, more productive cattle have more profit-making potential, but are inherently more risky.

Economics

Like natural environment, costs of production and prices paid for products are items over which beef producers have little control. Nevertheless, costs and prices have a bearing on the kinds of cattle we should be breeding. For example, when corn prices are low, larger cattle are desirable because they produce more end product and income to offset the fixed costs of an operation—taxes, land costs, etc. On the other hand, high corn prices favor smaller, earlier maturing cattle which require less time and feed in the feedlot.

Similarly, when winter supplement for the cow herd is cheap relative to the cost of feedlot rations, heavier-milking cattle are more profitable. They require more winter supplement, but their calves will be heavier and in better condition at weaning and will require less time and feed to reach market finish. In the reverse situation, however, when wintering costs are high relative to feedlot costs, less milk is desirable. It makes more sense in this case to save money on feed for the cow herd and produce calf gains more with feedlot ra-

tions than with mother's milk.

Economics even has an effect on the level of fertility that is needed for profitability. When the costs of producing replacements are high relative to the costs of maintaining mature cows and when the income from a cull cow is small in comparison to that from a calf, then high fertility rates are required. On the other hand, when replacements can be developed relatively cheaply and cull cows are relatively valuable, high conception rates are less important. In this situation, the most profitable operation might be one which markets a large number of open cows and saves back more replacements.

Market requirements have a direct effect on the kinds of cattle we raise. The market will accept any size carcass with any degree of finish, but if carcass weight and finish are not within certain limits, the economic penalties can be severe. Breeders of extremely large animals need to remind themselves of market specifications.

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The difficulty with making selection decisions based on economic conditions is that those conditions are so unpredictable. As seed stock producers, we are put in the position of having to make guesses about such things as the cost of concentrate feeds and the importance of hamburger in the national diet at some time in the future. The best we can do is try to stay informed and make our guesses as educated as possible.

Management policies

Different types of cattle are optimal under different management alternatives. For example, when calves are put in the feedlot immediately after weaning, efficient feed conversion is important. The most profitable cattle will be those which can grow very rapidly, yet reach market grade at a young age and acceptable weight. When calves are grown out in a stocker program before the feedlot finishing phase, however, ef-

ficiency of feed conversion becomes less critical.

Another example involves level of management. When management is slack at calving time, calving ease is extremely important. Its importance declines, however, as the level of calving management increases.

Mating system

The economic efficiency of a commercial cattle operation can be strongly influenced by the mating system being used. Efficiency will usually increase with: 1) increased hybrid vigor in calves and their dams, 2) increased sire size in relation to dam size, and 3) avoidance of calving difficulty. These factors have spawned a number of crossbreeding systems: rotational systems, where two or more sire breeds are used either in a pasture rotation or in sequence over time; terminal sire systems, where a large bull is mated to smaller cows and all offspring are marketed; combinations of rotational and terminal systems with names like rota-terminal and criss-outcross; and composite breeds, breeds which do not require crossbreeding in order to maintain hybrid vigor.

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These different systems have created a need for different types of seed stock. Rotational systems require a well balanced, general-purpose type of animal which is strong in maternal traits. This animal should have similar counterparts in each breed of the rotation. Terminal sire systems need a large, fast-growing animal with high carcass yield as the terminal sire and a moderate sized, maternal animal in the cow herd. The types of cattle that go into the formation of a composite breed need not be alike, but they should have complementary characteristics. For example, the hardiness of one type would combine well with the increased milk and growth of another type. Finally, all systems can use an easy calving bull to breed heifers.

A common fault of breed associations and seed stock breeders is that they portray their cattle to be all things to all people in all situations. The cattle would be more useful to the commercial man if they were bred to fit his specific needs. To the seed stock producer, this means breeding cattle to fit particular environments, management policies and crossbreeding systems. It also implies capitalizing on the strengths of the existing seed stock. It makes no sense, for example, to change cattle which are strong in calving ease and maternal traits into cattle which are best used as terminal sires.

Many breeds contain enough variability to allow strains within a breed to function in different ways. Within the Angus breeds, for example, it is possible to find cattle which excel in calving ease and maternal traits. Bulls of this type can be safely bred to heifers and will produce useful replacement females. At the same time, there are other Angus cattle which are growthier and no longer offer calving ease, but retain maternal value. These, too, have their place. It is not necessary, therefore (though it might reduce confusion in the minds of commercial cattlemen), that all breeders of a particular breed have identical selection priorities.

At this point you may be thinking: "All this is very perplexing. As a seed stock producer, I'm supposed to define selection priorities based on my knowledge of the commercial man's operation, yet some of the more important components of that operation like weather, costs, and prices are unpredictable. Besides, I have a lot of commercial customers, many with very different types of operations. Important traits like cow size and milk production appear to have optimal levels which vary from situation to situation. Aren't there any 'givens,' any traits I can select for and know I'm doing the right thing?"

I think there are, and I would list them in four categories:

1) **Survivability.** Relatively small changes in weaned calf crop can have large effects on net profit and overall efficiency. Any trait which affects weaned calf crop becomes important in this context. Such traits include paternal calving ease (weight and shape of the calf), maternal calving ease (the cow's pelvic structure and ability to calve), calf vigor at birth and afterwards, and mothering ability.

2) **Early growth rate.** With the possible exceptions of very stressful environments and terminal sire systems where extremely growthy terminal cross calves put excessive stress on their dams, rapid early growth is beneficial. We must be careful, however, that in selecting for early growth rate we do not increase birth weight and cow size beyond acceptable ranges. Weaning weight and yearling weight are good measures of early growth rate.

3) **Fertility.** Despite what was said earlier about the value of conception rate depending on economic considerations, there are compelling reasons to believe that *inherent* fertility is an important trait to breed into cattle. Highly fertile cattle are flexible. They can reach puberty at an early age at relatively low cost and will continue to reproduce under less than optimal feed conditions. A cow which might otherwise be considered too productive for her environment can still be adapted if she is sufficiently fertile. A high level of inherent fertility serves much like an insurance policy against droughts, harsh winters and long springs.

Selection for fertility has been played down in the past because of its apparent low heritability. With the exception of age at puberty, fertility traits in females are indeed lowly heritable. Scrotal circumference, however, is highly heritable, and there is a growing body of evidence to suggest that the most effective way to improve inherent fertility in both males and females is simply to select for larger scrotal size.

4) **Adaptability and convenience.** I have combined these two categories because a number of traits seem to fit in both. Adaptability traits are those which make an animal particularly suited to an environment. Included among these would be soundness, disease and pest resistance, and heat or cold tolerance. "Doing ability" might also be put in this category since, like the animal with high inherent fertility, the "good doer" can be seemingly too productive for an environment and yet be adapted nonetheless.

Convenience traits are those which contribute directly to savings in time, labor, drugs and facilities. Some examples are soundness, disease and pest resistance, and temperament.

Not all the traits mentioned in the four categories above are well understood, very heritable or very variable within a breed. Their virtue, however, is that if we succeed in changing them in the direction we want, we can be sure that we have made not only *change,* but *improvement.* We will never have to reverse directions at some time in the future, "undoing" generations of selection.

What is the best animal? Clearly, this article hasn't answered the question. Someday we may have computer programs which will help answer it. My goal in this article has been to provide an approach which you may find useful in deciding for yourself what is the best animal. AJ

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NEXT:
Designing a Breeding Program