Is Frame still in the Game?

By Jim Cotton
Editor

For cattle breeders, frame size became the equivalent of touch football's "go deep and I'll throw y' the long bomb." More than likely it would work -- often enough to be the clincher. With a little luck, it produced big results and quickly.

Some things never change. Might the beef industry's experience with frame scores be one of the knowns producers can count on? It appears to be predictable and capable of movement up or down.

With new emphasis on multiple selection and "balanced traits", where does frame fit in? Is its era over, or does it still rate our attention?

Several beef producers and respected beef cattle specialists have commented on the influence of frame. Many have addressed how selection for larger-framed breeding stock have changed or not changed the various aspects of beef production.

In a paper presented for the publication in the proceedings of the 1988 National Beef Cattle Conference at Stillwater, Hereford breeder **Burke Healey** of Southern Cross Hereford Ranch, Davis, Okla., outlined his impressions of frame and linear measurements. He characterized linear measurements as an innovation that swept through the beef industry and was abused just as rapidly. His forty years in the seedstock industry and extensive experience with linear measurements prompt him to conclude frame scoring can be part of a breeding program but it does not constitute a breeding program by itself.

Dr. Robert Long, animal scientist from Texas Tech University, strongly agrees in his presentation before the Beef Improvement Federation annual meeting at Albuquerque, N.M., May 12-14, 1988. Dr. Long flatly states, "the genetics of the calf determines his carcass characteristics at a certain weight." And, Dr. Long adds time is not of the essence. Whether the calf is backgrounded or fed on high concentrates from weaning, the research data still responds regardless of the economics -- "The genetic potential of the cattle dictates their carcass composition at any weight regardless of whether they reach that weight in a short or long period of time." You're playing with the same genetics. HOW you play is determined by your resources, finances, and the economics being brought to bear at the time.

In his presentation prepared for the Conference, Healey digested a wide variety and volume of data. The material amassed reveals all animals of a species are quite alike in terms of skeletal composition, muscle placement, and muscle proportion. In harmony with Dr. Robert Long's study at Texas Tech., Healy concludes "anatomy is constant."

He cites as one key the work by Australian Dr. Rex Butterfield. Dr. Butterfield's study showed various muscle systems between animals of the same species are proportional. Healy adds the work conducted at the Meat Animal Research Center at Clay City, Neb., substantiates this conclusion through a much larger scope in depth and sheer numbers.

TABLE 1
Slaughter data from 1,121 steers published by USDA Animal Research Center

	Live Wt.	Carcass Wt.	% Bone	% Lean	% Fat	Muscle Bone Ratio
Straight Hereford	970	609	12.7	67.5	19.8	5.4:1
Jersey x Hereford/Angus	886	550	12.9	66.9	20.3	5.2:1
South Devon x Hereford/Angus	992	632	12.6	68.1	19.2	5.4:1
Charolais x Hereford /Angus	1,107	704	12.9	70.9	16.2	5.4:1
Simmental x Hereford/Angus	1,109	699	13.1	69.7	17.2	5.3:1
Average	**1,008**	**638**	**12.8**	**68.8**	**18.4**	**5.4:1**

All of these steers were killed at the same physiological age--when they had five percent chemical fat in the ribeye (Choice Grade).

TABLE 2
Percent of total Retail Product* in each wholesale cut

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

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

At MARC, carcass studies were conducted in 1976 on more than 1,100 steers of many different breeds and crosses. The span included Jersey sires to Charolais and Simmental sires all used over Hereford, Angus, or Angus-Hereford crosses. As nearly as possible, all steers were slaughtered at the same physiological age. That age was determined to be when each animal had a five percent chemical fat composition in the ribeye muscle. This according to the research design was determined to correspond to USDA Choice.

The findings showed (TABLE 1) little difference in percent bone (average 12.8), percent lean (68.8), and percent fat (18.4). Muscle-to-bone ratio was 5.4 to one average and very uniform across all groups regardless of sire. This highly documented and significant amount of work was complemented by a study from Dr. Bob Koch at the University of Nebraska which he presented during the Range Beef Cow Symposium, Chadron, Neb., 1977 (TABLE 2). Again Jersey through Charolais sires were used and the percent of total retail product in each wholesale cut varied so little as to be insignificant.

Healy also notes the work by Dr. E.J. Warwick with identical twin calves at the USDA Animal Research Center at Beltsville, Md. Dr. Warwick concluded that every animal is a genetic package destined to grow to a certain size and carry so much finish at a certain weight regardless of when it gets there.

Work by Dr. Judge and Dr. Lidvall in Tennessee reveal feeding Angus or Holsteins or various other breeds, combinations, and frame sizes to a constant grade prove one basic factor. That one basic factor responsible for any difference in the growth or body composition of any two steers, bulls, or heifers at a given age is related to mature size -- the mature size they would attain if allowed to grow and develop to that point.

At Healey Brothers, work with linear measurements was carried on with the intention of fixing performance and nothing else. Uncovered during this work was what Healey calls the key to linear measures -- at a given age, bulls or heifers grow at almost the same identical rate regardless of frame size. Healey says the ration can influence the rate slightly, but unless it's so constituted to deprive and stunt the animal, it's insignificant. In his presentation to the Beef Improvement Federation annual meeting of 1979, Healey demonstrated an ADG experiment conducted in his herd during the postweaning phase to a year of age.

He compared the tallest 10 bulls with the shortest 10 bulls over four calf crops. He found growth varied so slightly as to be miniscule. Heifer calf crops proved the same. Frame sizes at that time (early 1970s) were 3.5 to 5.5. Healey points out work by the University of Missouri-Columbia confirms his discovery through its work on thousands of cattle of Frame Score 1 up through Frame Score 7.

Because this frame-age-grade relationship is complex and challenging to industry myths and misconceptions, it fascinates researchers and students searching for implications.

Drs. Harlan Ritchie, professor of animal science at Michigan State University, Lansing, and **Daryl Strohbehn**, his counterpart at Iowa State University, Ames, teamed up on a discussion of frame at the 1988 Cornbelt Cow-Calf Conference, Ottumwa, Iowa. There, they stated frame size "provides an estimate of rate of maturity, mature size, and percent carcass fat at a given live weight."

Frame size, they said, can be used to predict the weight at which young cattle will reach a given market endpoint such as Choice quality grade. These relationships are shown in TABLE 3. Drawing from similar data, TABLE 4 shows the approximate ranges in frame score which would enable both steers and heifers to fall within a given carcass weight range. Ritchie and Strohbehn point out as the acceptable range in carcass weight narrows, so too the acceptable range in frame score.

"For the time being," they suggest, "a carcass weight range of 600 to 800 pounds, which corresponds to a frame score range of approximately 4-plus to 6-plus would seem to meet the needs of the bulk of the beef industry." These researchers caution that industry leaders expect the range of acceptability to constrict in the near future.

From their investigation, Dr. Ritchie and Dr. Strohbehn consider the average frame score across the commercial cattle population in the United States is approximately 4.5. Range likely extends from 2.5 to 6.5. They cite the Beef Improvement Federation Frame Chart as offering some sound guidance for determining frame score by age and hip height. (See TABLE 5).

It's Healey's observation while discussing frame charts at BIF, that most beef animals attain most of their skeletal growth at a relatively early age. He suggests heifers have reached 80 percent of their total growth at weaning. At one year, 90 percent. Between the ages of 2 1/2 and 3 years, all skeletal growth should be complete. This is true for bulls also, he asserts, though steers fall out of the pattern as they continue to grow if allowed.

He thinks maturity settles in more quickly than many expect and that the myth that big cattle are late maturing achieving much of their mature size at three or even five years of age is a misconception. Healey tells his audiences that if slaughtered at the right point in its individual growth curve any beef steer of any frame size can display nearly ideal carcass characteristics.

'True, as those 1,100 steers killed each year . . . in the MARC work show, the weight at which this occurs varies with each frame size, but most steers can be killed at some point in their life to post a Yield Grade 1 or 2 and Choice marbling. When they do, they'll cut out about as well as any other steer.

TABLE 3

Approximate weight at Choice grade, lb.

Frame Score	Steers		Heifers	
	Live	Carcass*	Live	Carcass*
1	750	472	600	378
2	850	536	700	441
3	950	598	800	504
4	1,050	662	900	567
5	1,150	724	1,000	630
6	1,250	788	1,100	693
7	1,350	850	1,200	756
8	1,450	914	1,300	819
9	1,550	976	1,400	882

*Assuming a dressing percent of 63 percent (hot carcass basis).

TABLE 4

Approximate boundaries of frame size

Acceptable carcass weight range	Acceptable range in frame score
550 to 850	4- to 7
600 to 800	4+ to 6+
650 to 800	5+ to 6+
650 to 750	5+

They'll also express as much muscling, as good a muscle:bone ratio, and nearly equal performance or efficiency of gain."

The question of course at what age, weight, and size do they accomplish this. The feeding and packing industries are increasingly intolerant of wide variations and predictability. Their feed costs, interest rates, and customer outlets won't allow delays or products falling out of established marketing channels.

It's the old interplay of genetics and economics, first supporting each other, then antagonizing. At BIF, Dr. Long called for a new mindset when trying to make genetics support economics. Practice selection when trying to change cattle genetically, he told his audience, not performance testing.

TABLE 5

Bull Hip Height (Inches) and Frame Score*

Age in Months	Frame Score 1	2	3	4	5	6	7	8	9
5	33.5	35.5	37.5	39.5	41.6	43.6	45.6	47.7	49.7
6	34.8	36.8	38.8	40.8	42.9	44.9	46.9	48.9	51.0
7	36.0	38.0	40.0	42.1	44.1	46.1	48.1	50.1	52.2
8	37.2	39.2	41.2	43.2	45.2	47.2	49.3	51.3	53.3
9	38.2	40.2	42.3	44.3	46.3	48.3	50.3	52.3	54.3
10	39.2	41.2	43.3	45.3	47.3	49.3	51.3	53.3	55.3
11	40.2	42.2	44.2	46.2	48.2	50.2	52.2	54.2	56.2
12	41.0	43.0	45.0	47.0	49.0	51.0	53.0	55.0	57.0
13	41.8	43.8	45.8	47.8	49.8	51.8	52.8	55.8	57.7
14	42.5	44.5	46.5	48.5	50.4	52.4	54.4	56.4	58.4
15	43.1	45.1	47.1	49.1	51.1	53.0	55.0	57.0	59.0
16	43.6	45.6	47.6	49.6	51.6	53.6	55.6	57.5	59.5
17	44.1	46.1	48.1	50.1	52.0	54.0	56.0	58.0	60.0
18	44.5	46.5	48.5	50.5	52.4	54.4	56.4	58.4	60.3
19	44.9	46.8	48.8	50.8	52.7	54.7	56.7	58.7	60.6
20	45.1	47.1	49.1	51.0	53.0	55.0	56.9	58.9	60.9
21	45.3	47.3	49.2	51.2	53.2	55.1	57.1	59.1	61.0

* BIF Guidelines for Uniform Beef Improvement Programs (1986).

"In order to do this effectively, we must accumulate and use a complete -- and accurate -- set of performance records. To accomplish this, you must shorten your calving season, maintain uniform nutrition and management and thereby compare the cattle under the same conditions, at the same age, at the same time, and at the same place. Then use the records in selection. The procedure is performance selection, not performance testing."

What Dr. Long suggests is a retreat from single-trait, go for broke, selecting for frame in hopes it will drag a group of other measurable, highly visible traits along with it. In touch football or on the pro level, it's called the "Hail Mary", throw it toward the end zone and pray. In breeding performance cattle, selecting for frame did seem to stimulate growthiness, more impressive gains (in or out of a performance context), "bigger" cattle. Before long, though, the lack of a game plan revealed the fallacy of standing on frame alone.

Healey addresses the purebred breeder's retort when accused of producing seedstock that's "too big". "(W)e can justify somewhat larger cattle in our herds because most (commercial) herds are still considerably smaller (than Frame Score 4.5 to 5 plus). And Nature has an annoying habit of trying to regress all species to their average in every trait.

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

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

"If specifications for the box as it is today dictate, then we should be breeding Frame Score 4.5 to 5 plus cows to bulls of equal size. That's what it takes to have Yield Grade 2 animals grading Low Choice that fit the packer's weight range."

Bob Long comes to the crux of his presentation tackling the myths that surround carcass and frame. There are some critical distinctions.

1. Height at the withers is not an accurate measure of skeletal size. Measurements across moveable joints are not accurate since slope of shoulder and angle at the stifle and hock can affect such measurements greatly.

2. Skeletal size is not a measure of potential for reproductive efficiency, growth rate, or carcass desirability. In fact, selection for increased length of the long bones -- the length of leg -- is selection for late sexual maturity

3. Skeletal size (frame size) is not a measure of carcass composition or yield of edible portion -- in other words, beef.

Healey looks for a refining process now that there's a gene pool with numbers and in the acceptable range of frame sizes.

"We need to find the cattle within these ranges that perform the best and then stack their pedigrees. Keeping frame and performance constant and rolling generation after generation at those levels will give us genetically superior cattle with a high degree of repeatability. . . . That's what a breeding program is all about."

Healey lists traits to retain in today's beef cattle. Fertility, optimum levels of milk, structural soundness, good disposition, and survivability in droughts or blizzards. These traits, he says "endure forever.

"(S)ome of these are not very heritable, which means either your breed's got them or it doesn't. In the case of a lowly heritable trait, you can't live long enough in one lifetime to alter it very much by selection."

He suggests good breeding programs start with strong cow families in these enduring traits. Frame scoring is part of the mix, an important trait to help the breeder fix many traits. "But it's only that -- certainly no more," he insists.

"Tomorrow, frame scores may be employed to help us select for cattle of medium or small mature size. Never were frame scores intended -- at least on our part -- to be a `breeding program'."

Dr. Long presented three steers of identical frame size (TABLE 6) to make his point and incidentally, confirm Healy's experience. Note the significant differences in live weight though all three share the same frame essentially.

Note also in TABLE 7 the skeletons weigh essentially the same, 64 to 68 pounds. Tremendous differences, however, are displayed in pounds of muscle particularly. The heavily muscled steer has a muscle:bone ratio of 2X that of the thinly muscled steer. Long says these tables leave us with two key points:

1. The yield grade formula ranked these three steers essen-

tially the same, which is obviously in error. It penalizes the heavy steer, over-evaluates the light steer, while doing a good job on steer # 2, according to Dr. Long (See TABLE 8).

2. The frame size or skeletal size of these steers had nothing to do with desirability of their carcasses.

Says Dr. Long: "I . . . hope your conclusion would be something like mine . . . : Why would anyone use frame size in the evaluation of cattle for composition?"

"Remember," he continues, "frame size tells you nothing about the composition of the carcass, growth rate, or reproduction efficiency. The larger the frame size, the longer the feeding period required to reach slaughter condition. When compared at the same age, the larger the frame, the larger it will be at maturity and the longer it will take to reach that point."

But frame is where we've hung our hat, so to speak. It's given us the "long bomb" and turned breeding programs around. Dwelling on frame has spelled success for more than one faltering seedstock breeder. If we hang more meat there, what's the difference if we get there by a grandstand toss for the end zone or by a sustained drive?

"We often hear the remark," counters Long, " `I like a lot of length and elevation in my cattle because it gives me more space to hang muscle.' This is parallel to doing business with a big bank in the hope your cash deposits will increase accordingly. If you want to evaluate cattle for muscling, you must measure the muscle. Muscle is beef and beef is muscle. It makes no sense to select against the growth and development of muscle."

Long lists four measures of production worthy of consideration in evaluating beef cattle: 1) Reproductive efficiency; 2) Increase in weight per unit of feed; 3) Composition; and 4) Longevity.

The producer's goal must be to maximize productivity in each of these traits. Breeds and strains within breeds are the available options at present. As Dr. Long points out, the conflicts are already built in, are known, and must be avoided or neutralized if we're going to keep on top of the challenge. The ideal cow surviving on the range conflicts with desirable carcass composition. Maximum gains and ideal composition do battle with reproductive efficiency.

Frame is one of those options, but today's strategy must include a book of plans. Frame will be called upon but its antagonism toward some important traits of today and the future must be weighed in the total breeding program.

TABLE 6
Muscle: Bone relationship among slaughter steers (Live Measurements)

Steer No.	1	2	3
Live Wt. (lbs.)	1,450	1,300	1,005
Length of Body (in.)	60.23	60.23	59.84
Rump Length (in.)	20.07	20.07	20.47
Ht. Withers (in.)	51.96	51.57	52.36
Ht. Hips (in.)	53.54	53.14	53.93

TABLE 7
Muscle: Bone relationships among slaughter steers (Dissection Data)

Steer No.	1	2	3
Lbs. of Bone	64	68	67
% Bone	13.1%	16%	23%
Lbs. of Muscle	320	262	168
% Muscle	66%	63%	59%
Lbs. of Fat	104	81	53
% Fat	21%	19%	18%
Muscle: Bone	5.01	3.88	2.52
Muscle: Bone 1M Fat Included	5.16	3.94	2.61

TABLE 8
Muscle: Bone relationships among slaughter steers (Carcass measurements)

Steer No.	1	2	3
Carcass Wt.	976	820	570
Dress %	67%	64%	57%
Maturity	A75	A50	A75
Marbling	Small 30	Slight 80	Slight 60
Quality Grade	Ch-	Gd+	GdO
Fat thickness (in.)	.3	.3	.12
Rib Eye Area (Sq. in.)	18.1	14.3	9.9
% KHP	3.0%	2.5%	2.5%
Yield Grade	1.8	2.3	2.3

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