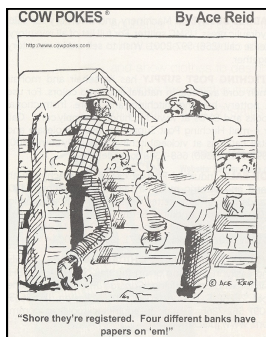


Strategic Use of Heterosis

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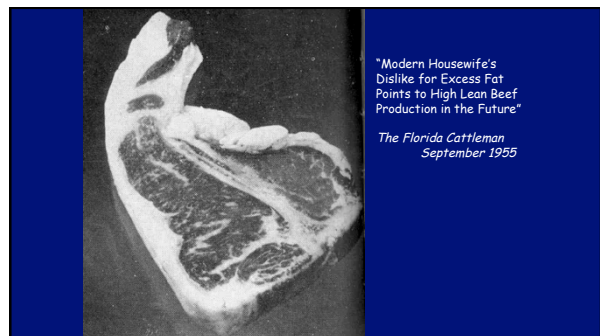
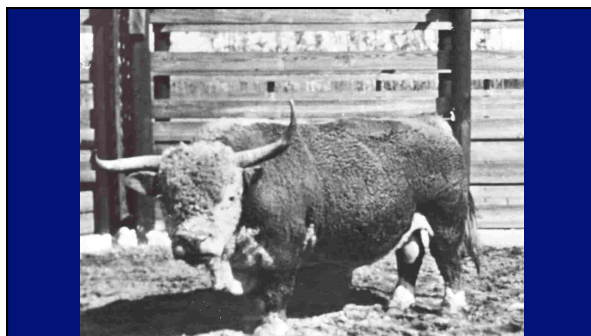
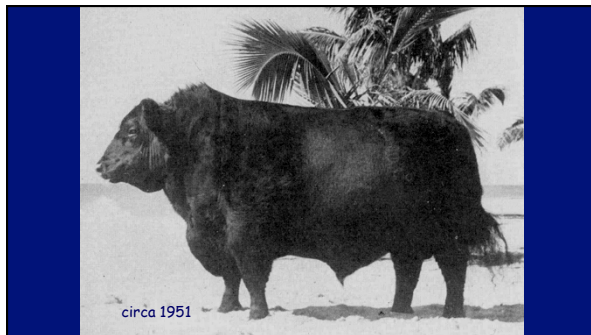


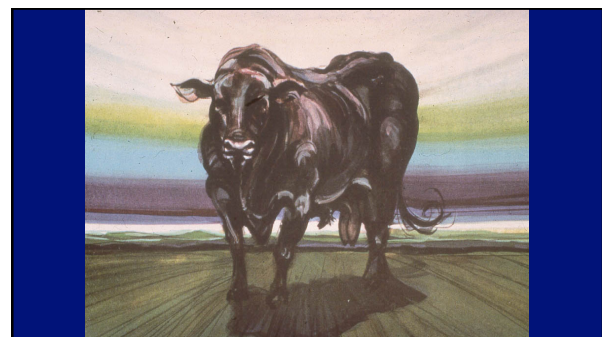
History is
important



"Shore they're
registered. Four
different banks
have papers on 'em!"







"The breeding of beef cattle has made a fad of certain breeds, even going so far as to set up a color instead of milk or beef producing qualities as the primary selection criterion"

Discussion of the cattle industry in the 1890's, James Westfall Thompson

Is color a good indicator of uniformity?



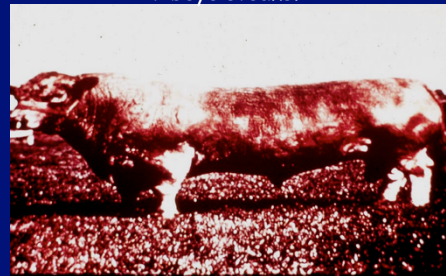
We should learn from the past but not live in it!

How much marbling is too much?



How much muscling is too much?

Can we make an animal with too many ribeye steaks?



The beef cattle industry has a history
of going just a little too far in one
direction

"To breed for optimum means to have a
target in sight beyond which you don't want
to go. If your goal is to maintain an optimum
level for any trait, the evidence of your
accomplishment is not visible change, but
lack of it."

Dr. Rick Bourdon

Are the extremes profitable?
Are the extremes even functional?

Did the poultry industry obtain their
current position by single-trait selection?

"I am weaning 750 lb calves,
selling them for a quarter a
pound over market and
achieving 99% pregnancy
rates.....with straightbred
cows"

What does it cost?

What are the long term consequences?

The Dairy Industry Uses Straightbreeding

Fertility in Dairy Cattle

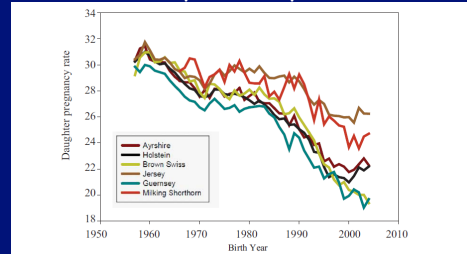


Figure 1. Historical changes in phenotypic measurements of daughter pregnancy rate in United States dairy breeds from 1957-2005. Data were obtained from United States Dept. of Agriculture Animal Improvement Program Laboratory (<http://aipl.arsusda.gov/eval/summary/trend.cfm>).



How much should we modify the environment?



Too often we select animals in a favorable environment with the hope that they will be productive in a harsh environment.

Or we feed more!

Genetic Antagonisms

No one breed maximizes/optimizes the 3 M's

Maternal

Muscle

Marbling

In all environments

Genetic Antagonisms

Best Managed by Crossbreeding

Do We Need to Crossbreed?

Should we be asking this question?

"Say ... what's a mountain goat doing way up here in a cloud bank?"



Mongrelized Mess?



Too many breeds?

Is crossbreeding the problem?

Or is it inappropriate use of
breed diversity?

Have we always been upfront
about strengths and weaknesses
of breeds?

How many of you have turned away
a bull customer and told them "you
don't need my breed of bull!"

We wholesale promoted
crossbreeding in the 1970s-1990s
without regard to the system or
breeds used in each system

Rotational Systems Circa 1990



Charolais Simmental

Limousin

By-Product Heterosis



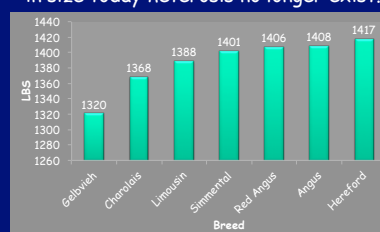
Benefits of Crossbreeding

Hybrid vigor/Heterosis
Breed complementarity

Crossbreeding is the most rapid means of
meeting changes in market demand.

Does Heterosis Still Exist?

It has been suggested since many breeds are similar
in size today heterosis no longer exist.



Does Heterosis Still Exist?

Breed complementarity would be reduced as a result of breeds being similar in size but heterosis should not be reduced!

Which traits have the most monetary reward?

Trait	REV	h^2	%HV	REV*
Reproduction	10	<20	10	5
Production	2	20-40	5	2
Product	1	>40	0	2

*Adjusted based on current trends towards product

Adapted from Willham, 1967, Melton 1995

Where are your priorities?

Beef Cow Efficiency is Reproduction — Or Else!

Earle Klosterman-Ohio State 1976

Gulf Coast Priorities



Performance of the Brahman cross female (F1 Brahman x British)

As compared to straightbreds

- Calving rate +10%
- Calf survival +5%
- Weaning rate +12.5%
- Calf weight at weaning +70 lbs

Louisiana - Franke, 1980

Performance of the Brahman cross female (F1 Brahman x British)

As compared to straightbreds

- Calving rate +16%
- Calving interval -9%
- Weaning rate +19%
- Weaning weight +13%

Florida - Riley et al., 2007, 2014



The Brahman F1
is the Cadillac

Red Cadillac



Black Cadillac



Spotted Cadillac



Hybrid Vigor-Are We Ignoring the Facts?

- Is highest in factors affecting efficiency of cows
 - Fertility
 - Calf survival
 - Longevity
- Is intermediate in growth traits
 - Milk Production
 - Weight gain
- Is low in carcass traits
 - Fat thickness
 - REA

Hybrid vigor for most traits seems to be
greatest in sub-optimal environments

Heterosis

Trait	Individual	Maternal	Total
Calving rate	0	6	6
Weaning rate	0	8	8
Pubertal at 15 months	15	-	15
Survival to weaning	3	1	4
Birth weight	4	2	6
Weaning weight	5	6	11
Milk production	-	6	6
Weaning weight/cow exposed	-	-	18
Cow longevity	-	-	38
Cow lifetime productivity	-	-	23

Adapted from Taylor 2007 and Kress 1999

Straightbreeding

$$2+2=4$$

Crossbreeding

$$2+2=5$$

Crossbreeding with the Brahman
cross female

$$2+2=6$$

Lbs of calf weaned per cow
exposed can be increased 25-35%
or more due to the cumulative
effects of hybrid vigor!

More than half of this advantage
is dependant on the use of a
crossbred cow!



Twenty-one year old F₁ Brahman-Hereford cow with
eighteenth calf at the East Texas Pasture Laboratory,
Lufkin. Lifetime average adjusted 205 day weaning weight
of her calves was 505 lbs.

Cow Longevity

Breed	Age
Angus	10.3
Hereford	9.8
Brahman	9.7
Angus x Hereford	11.7
Brahman x Angus	14.7
Brahman x Hereford	13.2

Texas - Rohrer et al., 1988a

Cow Longevity- Are they really
productive to an OLD AGE?

Brahman x Hereford Cows Mated to Simmental Bulls


Age	Weaning Wt
3-12 years	565
12-17 years	569

Texas - Gaertner et al., 1992

1970 Chevrolet
Custom Deluxe

AC AND a
RADIO!

\$4,000



Longevity
1970 Chevrolet

- Change oil
- Tighten 3 belts
- Change belts
- Check points
- Change plugs
- Rust holes in muffler
- Check brake fluid
- Set timing
- Tune carburetor

Sold in 1983 with
54,000 miles!!
"Worn Out"

1997 Ford 7.3L
F250 Super
Duty

All the Bells
and Whistles
for 1997

\$32,000



Longevity
1997 Ford 250 Super Duty

- Change oil
- Never tightened a belt
- Change belt.....one belt
- No Points
- Never touched glow plugs
- Original muffler
- Never check brake fluid
- Never touched motor
- Never touched injectors
- 3-4 clutches

412,000 miles!!
"Just getting broke
in"



The
crossbred
cow is
similar to
the 7.3 L
diesel

The increased longevity of these
Brahman crossbred females results in
fewer replacement females being
required thus allowing for more
intense selection?

Thrift and Thrift, 2003

First Question when Choosing a Crossbreeding System?

Do I raise or purchase my replacements?

Depends on the size of the operation

Most producers are going to raise their own replacement heifers even if they should not!

Crossbreeding systems do not have to be based on the F1 cow

Simple Systems that Produce Replacement Females

Breed	heterosis relative to F1 (%)
2 breed rotation	67
3 breed rotation	86
2 breed composite 3/8 5/8	47
3 breed composite $\frac{1}{2}$ $\frac{1}{4}$ $\frac{1}{4}$	62.5
4 breed composite $\frac{1}{4}$ $\frac{1}{4}$ $\frac{1}{4}$ $\frac{1}{4}$	75
Terminal	100
with F1 female purchased	

So how can we use this "Ideal" cow and still produce an "Ideal" calf that will meet market demands?

Planned Crossbreeding Program

Terminal Sire!

Terminal Sire

- Maximizes hybrid vigor
- Takes advantage of complementarity
- Often expensive to purchase females
- Only 50% of cows can be bred this way
 - The rest must be in a system that produces replacements

Small Producer Scenario

- 30 "Ideal" cows (one bull herd)
 - Purchase "Ideal" bred replacement heifers
 - Mate cows to Continental bull (terminal sire)
- Maximizes hybrid vigor
- Cow type adapted to the environment
- Requires only one pasture

Terminal sire does not always mean lb.?



What about Composites?

MARC I	1/4 Braunvieh, 1/4 Charolais, 1/4 Limousin, 1/8 Hereford, 1/8 Angus
MARC II	1/4 Gelbvieh, 1/4 Simmental, 1/4 Hereford, 1/4 Angus
MARC III	1/4 Pinzgauer, 1/4 Red Poll, 1/4 Hereford, 1/4 Angus
RX3	1/4 Hereford, 1/4 Red and White Holstein, 1/2 Red Angus
CASH	23% Hereford, 23% Angus, 34% Brown Swiss, 20% Charolais
Santa Cruz	1/2 Santa Gertrudis, 1/4 Gelbvieh, 1/4 Red Angus
Stabilizer	1/4 Red Angus, 1/4 Hereford, 1/4 Gelbvieh, 1/4 Simmental
Rangemaker	1/2 Angus, 1/4 South Devon, 1/4 Tarentaise
Rangelover	Red Angus, Polled Jersey, El-Monterey, Sallers, South Devon, Wagyu
Noble Line	3/8 Brahman, 3/8 Angus, 1/4 Gelbvieh
Senegus	3/8 Senepol, 5/8 Angus
Hatlander	3/16 Brahman, 5/16 Simmental, 3/16 Senepol, 5/16 Angus
GCC	1/2 Red Angus, 1/4 Charolais, 1/4 Tarentaise
Alpine Black	3/4 Angus, 1/4 Brown Swiss
Profit Maker	?
Rangelander	Angus, Brahman, Hereford, Jersey, Red Poll, Shorthorn???
Beef Machine	Hereford, Red Poll, Dutch Friesian, Angus, Brown Swiss, Simmental

American Breeds/Composites

Straightbreeding using "American breeds"
example-Brangus x Brangus (Hi=47%, Hm=47%)

Advantages

- simple-only requires one pasture and one breed of bull
- uniformity in color ?
- produces replacement females
- takes advantage of some heterosis
- can utilize breeds that are adapted to hot climates

Disadvantages

- does not take full advantage of heterosis
- does not take advantage of breed complementarity
- uniformity in color ?

Simple system

- 100 Brangus cows
 - 30 mated to Brangus bull to generate females
 - 70 mated to Continental bulls (terminal sire)
- Produces replacements
- Provides hybrid vigor
- Cow type adapted to the environment
- By-product - Brangus steers - Black
- Requires only two pastures

Composites

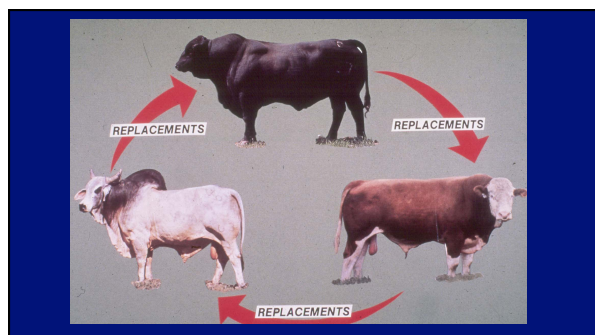
Example- MARCII x MARCII (Hi=75%, Hm=75%)

Advantages

- simple-only requires one pasture and one breed of bull
- uniformity
- produces replacement females
- takes advantage individual and maternal heterosis
- many composites are the "ideal type"

Disadvantages

- Current composites are not adapted to hot climates
- Not currently available in large numbers



Crossbreeding systems do not have to start with purebred cows

Crossbreeding systems do not have to start with purebred cows

Phenotype cows

Angus type
Herford type

British type
Continental type

Red
Black

With ear
Minimal ear

Utilization of a Roto-Terminal Crossbreeding System

- Approximately 50% of cows (older, less productive, late calvers) can be mated to terminal sire bulls to produce calves with more weight and value.
- Takes advantage of HV and breed complementarity
- Produces adapted replacements in the rotational herd.
- Requires a large number of cows to make this system work (500 hd min).
- Must market multiple types of calves
- Requires multiple pastures

Straightbreeding Concerns

- Use of a small number of sires via AI
- Use of a small number of dams via OPU and In-vitro fertilization
- Narrow the genetic pool in the search for the "PERFECT ONE"

There is not just one way...many producers are very successful with a straightbreeding program

Crossbreeding studies require time and resources that are often not available today.

Just because the data is old doesn't mean heterosis doesn't exist anymore.

Deciding to crossbred is a long-term decision with implications

Even the best plans sometimes fail

What are Your Expectations?

Be realistic about what crossbreeding will do for your operation

You cant make a silk purse from a sows ear. If you crossbred with junk you will get junk

Crossbreeding is one of the most cost effective technologies in the beef industry!

More technology doesn't necessarily make us any more advanced unless we know how to put it to use!

Even with the promise of genomics,
crossbreeding is still a valid and
important tool to improve performance

Strategic use of heterosis

Use a crossbred cow...

it is one of those things that we have
yet to come up with a better
alternative for...

Questions?

Why do people always expect
teachers to answer questions? I
am a teacher because I want to
ask questions. If I had answers,
I'd be a politician.