Canadian Bovine Genomics Workshop

September 14, 2009

Calgary, Alberta

Canadian Bovine Genomics Workshop – September 14, 2009

"Past, Present and Future Opportunities in Cattle"

Robert Church

Cattle in Northwest Territories

1870-1900

Bison – head into wind – “gone with the wind”

Texas Longhorns – thin hided – “with the wind”

Shorthorn – F.W. Stone, Guelph 1841

Angus – W. Brow, Guelph 1876

Hereford – F.W. Stone, Guelph 1860

Ayrshire / Holstein / Shorthorn (D)

Thick hided, Meat and Milk

- **Early purebred breeders in central Alberta supply Cochrane Ranch, A7, Burns, Pallesen, etc.;**
- **Outfits brought in bulls/heifers to add hardiness, Fleshing ability, Milk**

Original Genetic Revolution

1900-1950's

1901 - Territorial Purebred Cattle Breeders – Calgary Bull Sale

1905 - ACBA: world's largest consignment sale

- National Records Board – Livestock Pedigree Act

- Era of Master Breeders – big rough cattle to thick, small, smooth beef cattle. Herefords, Shorthorns, Angus, Galloway Highlord: Ayrshire, Holstein, Jersey, Guernsey, etc.
- Cattelo – One Four – Hobart Peters – behaviour, tough
- Snowlander – Charlie Flick – reproductive Foragers
- Line I – Miles City – Bob Woodward
- Beefmaster; Santa Gertrudus

Explosive Genetic Revolution

1950's-1970's

1956 : LK started beef AI from Guelph/Beckton
beef and dairy progeny test

1961/3: LK – Western – Burns – Safeway
built EPDs for ADG, Carcass
- Kinsella hybrids build on Holstein
sire progeny tests with AI
- Berg . Fredeer et al.

1967-68: Hays.Williams.Wells – Continental
multipurpose breeds add to gene pool with <u>worldwide demand</u> – BCAI, ABS, Prairie, Western

1969: Hyline, Shaver – DNA parentage – Monro

1970-72: Alta. Embryo Transfer – Rowson et al.
- litters, split embryos, IVF
Protein – DNA parentage – HoFA – Bovacar
For sires, donors, parentage tests by purebred breed associations

1976: VIDO – Bigland, Acres, Babiuk
- Childrens Hospital Genetic Testing Lab – karyotype – DNA . Hoar

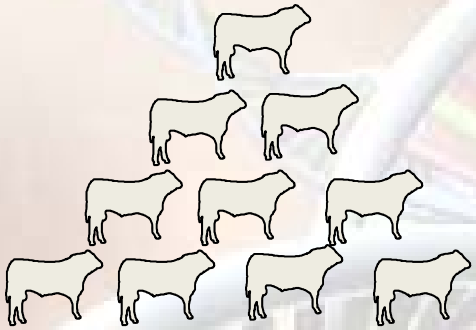
1986: Animal Genetics Laboratory . U of C

Bovine Genomics

1980-2005

- Pedigrees with EPDs, Parentage DNA testing; abnormalities testing and markers introduced.
- First DNA markers – polled gene Herefords
  Ross Bricker
  - Muntjac sexing – Linn/McWhir
  - Dairy Progeny Testing / ET Marketing
- Heterosis Hybrid Programs - Beefbooster
- Human Genome Project
- Sequencing gels – SNPS, Markers, etc. enter marketing programs
- Global Bovine Genome Program, and
- U of A Genomics Program – Moore et al.
- Pedigreed Breeding Stock sales of live animals, semen, embryos becomes major worldwide industry. Alta. Genetics world leader in elite genetics of dairy and beef

ADDRESSING THE "PHENOMIC GAP"



DNA
Blood
Tissues

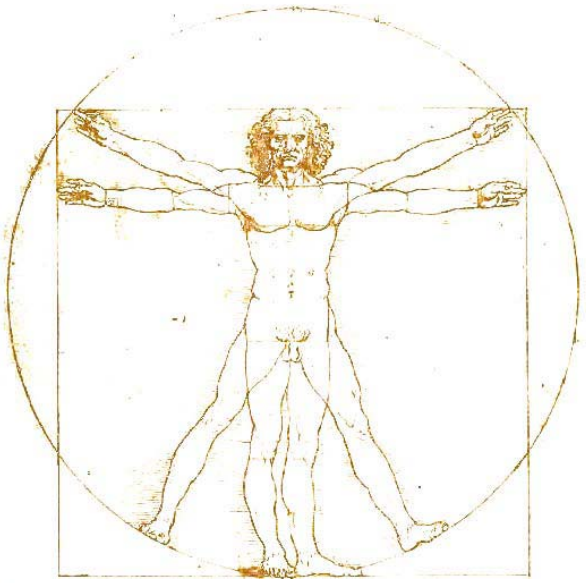
40-50 sires
4-5 herds, 1000 cows/yr
670-800 progeny tested/yr under standard conditions

GENOTYPES/PROTEIN PROFILES
50,000 SNP data base
Proteomics, Bioinformatics,
Marker Assisted Selection
Leptin, IGF-1, UCPs, NPY, calpains, calpastatin, DGAT, desaturase, etc.

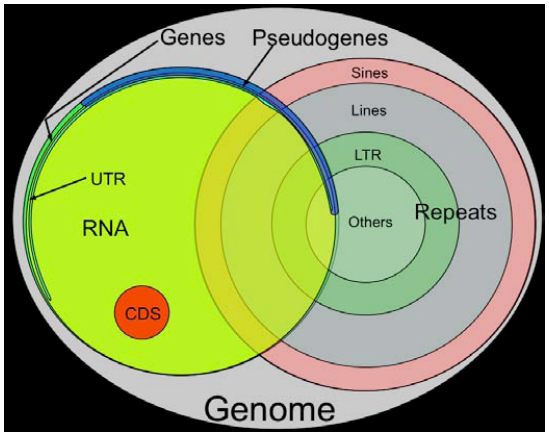
PERFORMANCE DATA
Birth wt, pre- & post wn ADG
Feed efficiency (RFI),
Ultrasound fat, marbling & REA
Basic carcass traits & body composition
Meat quality & palatability at 0, 7, 14 d post-mortem
Fatty acid profile, trans%, saturated %, unsaturated%, etc

ASSOCIATIONS plus MARKER VALIDATION STUDIES

TOTAL NUCLEOTIDE INVENTORY



Human Germline DNA



Gut Flora/Viral DNA	Mitochondrial DNA	Circulating DNA
• $10^{13} – 10^{14}$ microorganisms	• Circular • 37 genes	• Traces from Damaged Cells
• 100 x more genes than humans	• ~16 kb • 2-10 copies per MT	• Detects disease related events

Future: Healthy Livestock – Healthy People

- **454 Mass sequencing and high capacity search engines**
  add Total Genomics ↔ Epigenetics Analysis for:
  - **Chronic and acute disease?**
  - **BSE analysis**

  Urnovitz . Sensen . Czub
  - **HIV analysis – Montague**
  - **BSE . CWD blood test**
  - **Chronic Disease is phenotype for total genomics, environment and diet**
- **The eye and commitment of the livestock breeder in the environment where livestock are reared will determine profitable livestock:**
  Based on Pedigrees enhanced by EPDS, Marker Panels and Total Genomic Profiles.

Proof of Concept- From 454 to Routine Lab Tests

5 sequences discovered in 454 Sequencing were selected and developed into a quantitative Real-time PCR assay -13 BSE vs 38 Normal Cow Controls

	Initial Reactives	Initial Non-Reactives
BSE	13	0
Normals	8	30

RT-PCR Results

Screening Results: 100% Sensitivity, 79% Specificity

	Repeat Reactives
BSE	13
Normals	0

Confirmation Test

Final Results with Confirmation Test: 100% Sensitivity, 100% Specificity

Therefore, Chronix can translate 454 results into a screening and confirmation test for BSE with 100% Sensitivity and 100% Specificity