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2018 Agricultural Outlook Forum “The Roots of Prosperity”

Livestock Reproduction Meets Modern Technology

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National Institute of Food and Agriculture





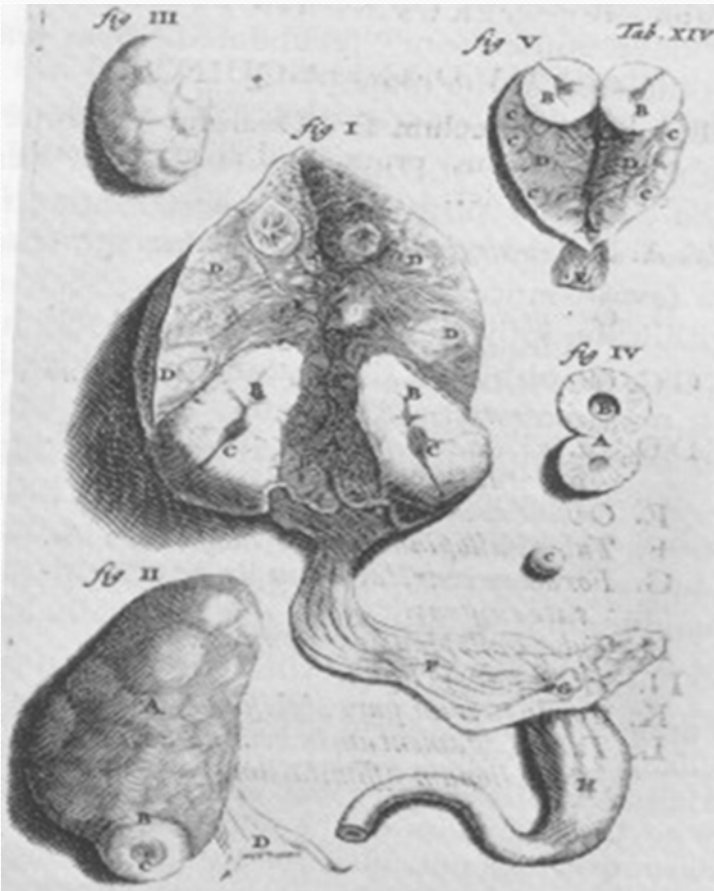
Overview

- Contemporary Science Boosts Fertility in Cattle
 - Dr. Tod Hansen, Colorado State University
- The Partnership Between Land Grant Universities and NIFA Assists the Livestock Industry
 - Dr. Mark Mirando, USDA-NIFA
- Reproductive Technology and the Beef Industry's Long Range Plan
 - Mr. Coleman Locke, J.D. Hudgins Inc., Hungerford, TX





1666 to 1676 – A Decade of Discovery

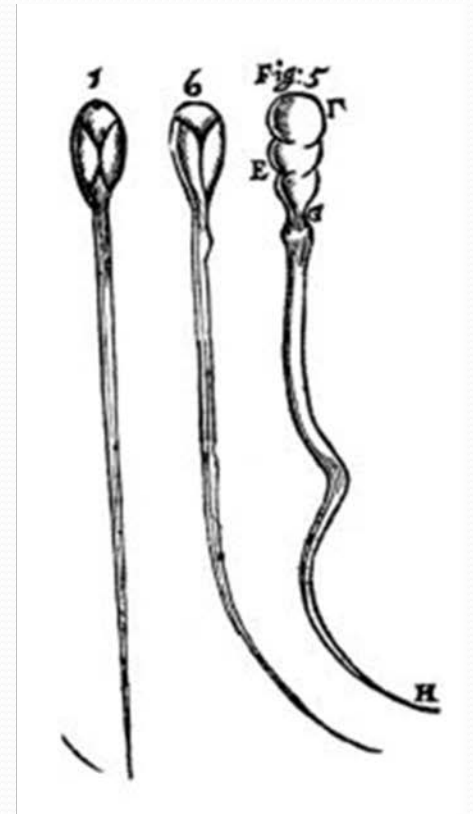


Progression of Discovery

- 1677 – Use of the microscope to observe spermatozoa



Anton van Leeuwenhoek

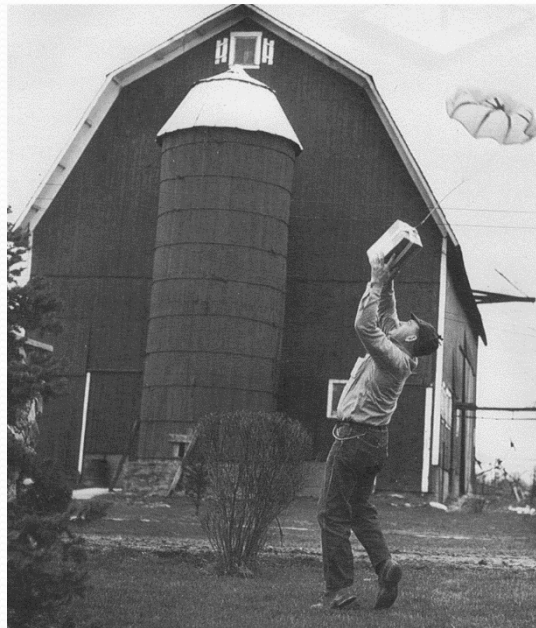


Science Over Time

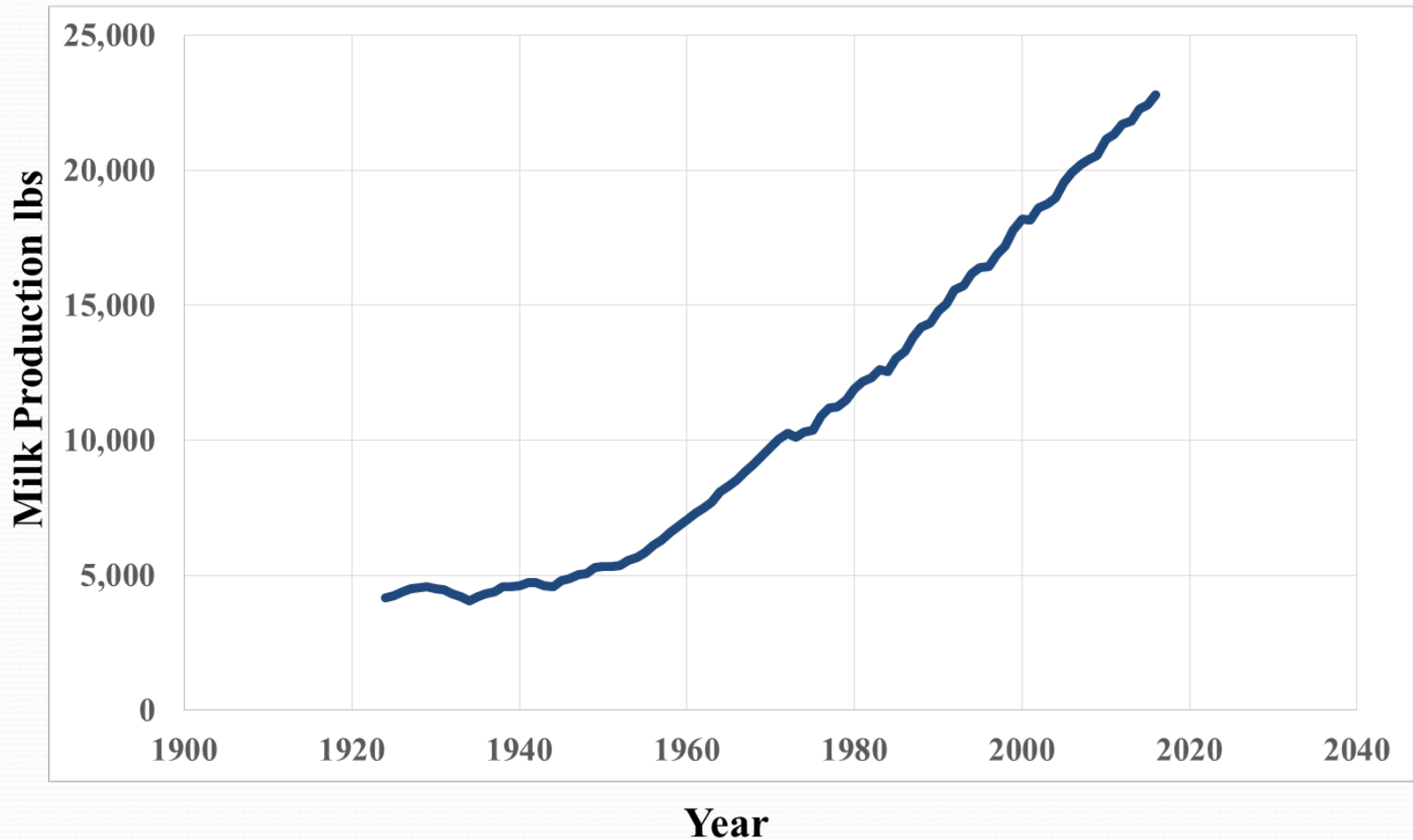
- 1800's – Birth of endocrinology (Ablation – Replacement)
- 1920s to 1940s – Purification of reproductive hormones
- 1930s to 1950s- Gamete preservation – extending and freezing semen
- 1960s – Use of antibodies as reagents (e.g. RIA)
- Late 1970s to 1980s – Molecular endocrinology
- 1980s – Sex sorted semen
- 1990s - Introduction of “omics” to reproductive research and gene knockout technology (i.e. mouse)
- Today- birth of CRISPR/Cas9 technology (Gene editing)

When It Has To Be There Overnight

- 1940 – 1952 Extended semen delivery
 - Airdrop from planes
 - Mail
 - Bus



Artificial Insemination Leads to Genetic Improvement

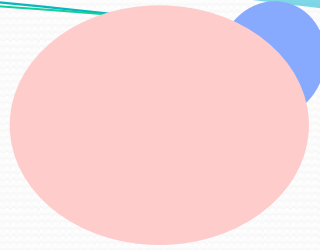
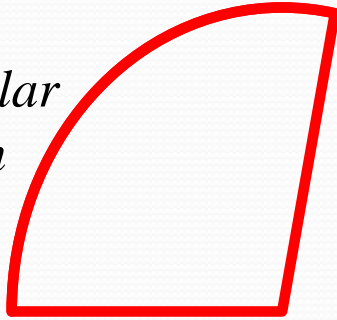


Assisted Reproductive Technology

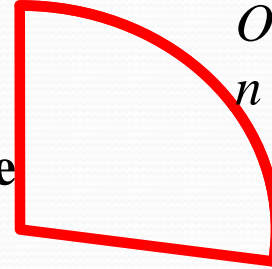
- Trying to manipulate reproduction in domestic animals
 - AI procedures
 - Cryopreservation of sperm
 - Estrous synchronization
 - Embryo transfer (ET)
 - *In vitro* fertilization (IVF)
 - Cloning
 - CRISPR/Cas 9



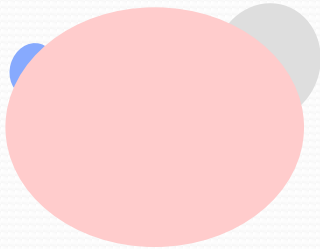
*Follicular
Growth*



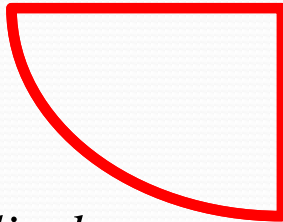
Mature follicle



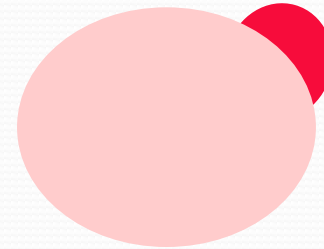
Ovulation



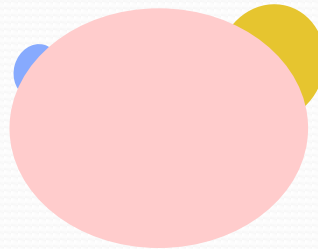
**Corpus
albicans
Small follicle**



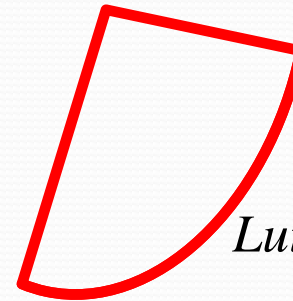
*Follicular
Growth*



**Corpus
hemorrhagicum**



**Corpus luteum
Small follicle**



Luteinization

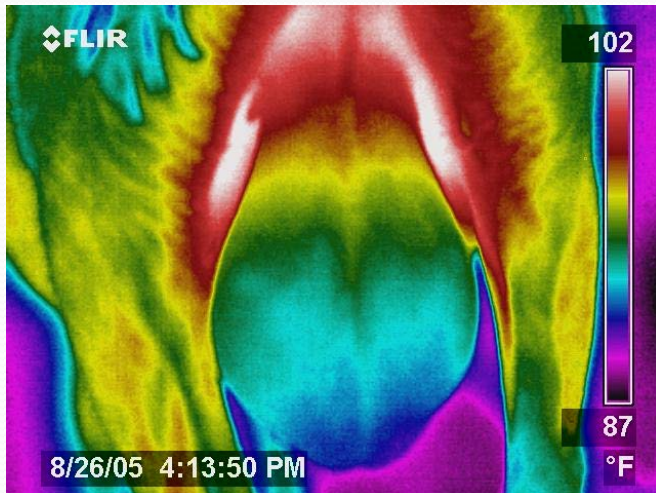
What about the male?

“Recognizing that even with the superovulatory regimes used in embryo transfer to harvest the genetic material, the dynamic and continual aspects of producing mature gametes by the male emphasizes the much greater impact of the bull, when compared to that of the cow, in adding to the gene pool of a population” (R.W. Godfrey, PhD Dissertation, Texas A&M University, 1987)



Every Sperm Is Sacred

- Sperm production is continual post-puberty
- Easy to collect germplasm
- Indirect and direct evaluation
 - Testicular size
 - Semen collection and visual assessment
- Sexing technology



Partnership with USDA-NIFA

- Support for research, outreach and education programs
 - 1862 Land Grant Universities
 - Insular Land Grant Institutions
 - 1890 Land Grant Institutions
 - Non-Land Grant Ag Schools
 - Tribal Colleges
 - Agriculture Research Service
- Capacity funds and competitive grants
 - Capacity funds – Fast response to or long term studies of state level priorities (Hatch, Smith-Lever, McIntire-Stennis, Evans-Allen)
 - Competitive grants – specific scientific concept that is not as time sensitive or local (Agriculture and Food Research Initiative (AFRI))

Where the money goes

- Research - Agricultural Experiment Station (AES)
- Outreach - Cooperative Extension Service (CES)
- Teaching – Colleges of Agriculture
- Infrastructure support is needed



What the money does

- Training next generation of scientists
 - Undergraduate and graduate students
 - Post-Docs
 - Early career faculty
- Collaborations



Practical Applications

- How does all of this work get out to the stakeholder?
- CES is the primary conduit between the science and the stakeholder in many cases
- Takes the partnership one step further



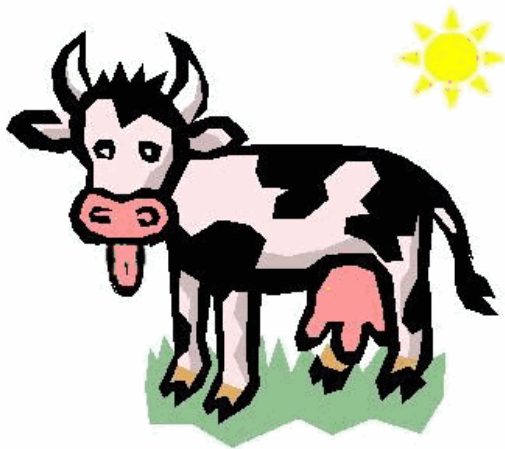
Research vs Real World

- Research impacts “the bottom line”
- Scientists take the risks so producers don't have to
- Application of research results needs to be balanced
 - Cost vs Benefit



Measuring Reproduction

- Reproduction is difficult to select for
 - Low heritability (0.06 to 0.22)
- Can be impacted by many factors
 - Nutrition
 - Heat stress
 - Genetics
 - Behavior



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