

The background of the slide is a painting depicting a rural scene at sunset. In the foreground, a farmer wearing a hat and overalls is seated on a vintage tractor, viewed from behind. The tractor is dark-colored with large, spoked red wheels. It is moving through a field of tilled, reddish-brown earth. In the middle ground, another farmer is visible, plowing a field with a team of horses. The background features a large, dark barn with a silo and other farm buildings under a sky with soft, orange and blue clouds.

From Moon Farming to Satellite Farming: The Evolution and Future of Agriculture in America

Gary Moore
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Light of the Moon,
Waxing Moon

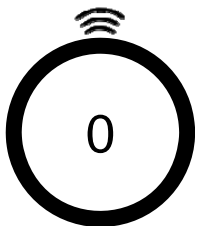


Moon Phases

Dark of the Moon,
Waning Moon

When is the best time for “setting” fence posts on the farm?

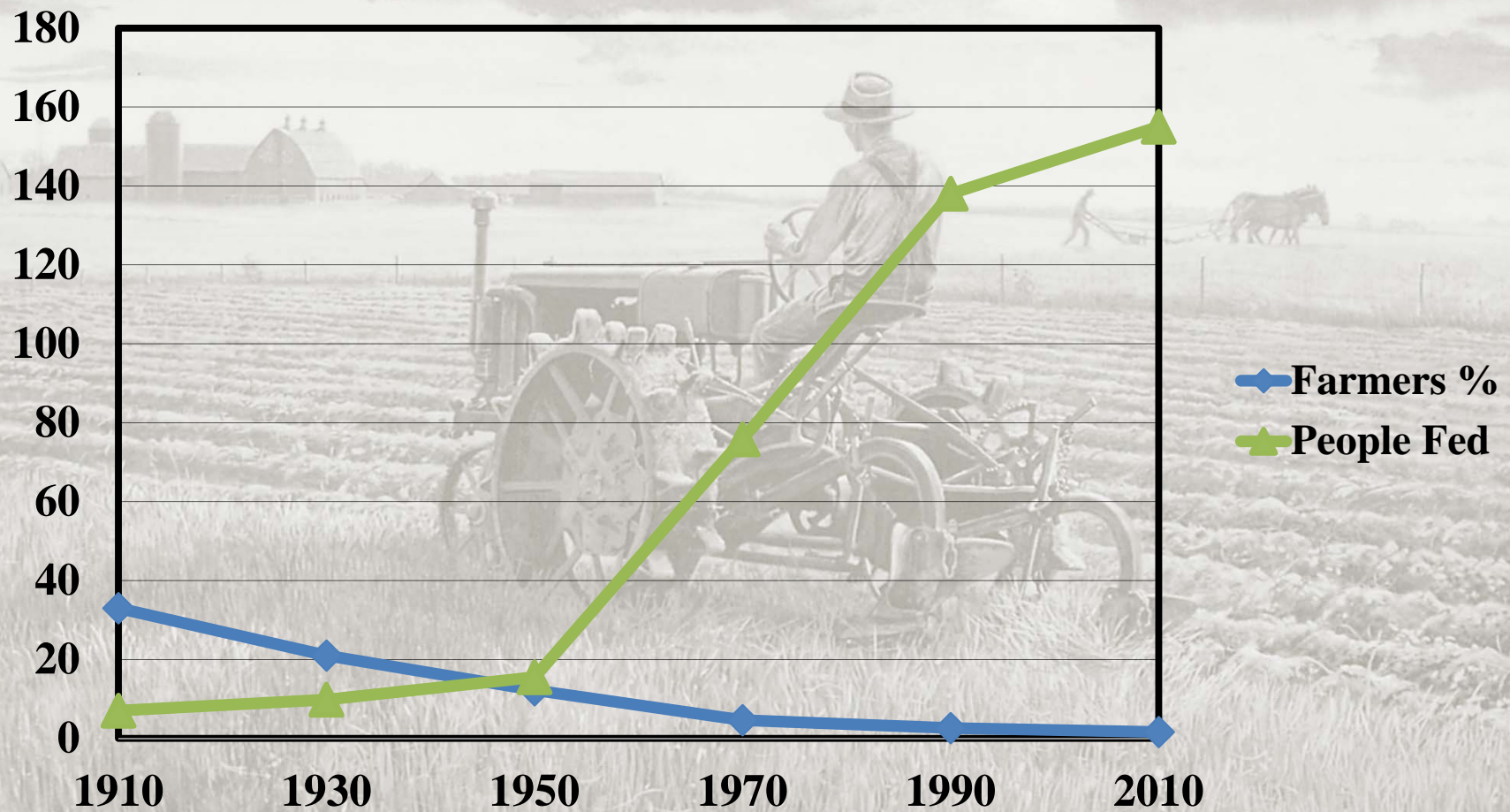
1. Full Moon
2. Waxing Moon
3. Waning Moon
4. Dark of the Moon



Farming by the Moon

- Light of the Moon (waxing)
 - Prepare the soil
 - Plant crops that grow above ground
 - 1st Quarter - Plants that produce seed outside the fruit
 - 2nd Quarter - Plants that produce seed inside the fruit
- Dark of the Moon (waning)
 - Cultivate
 - Plant crops that grow below ground
 - Don't plant in the 4th quarter of the moon
 - Harvest crops
 - Dig Postholes

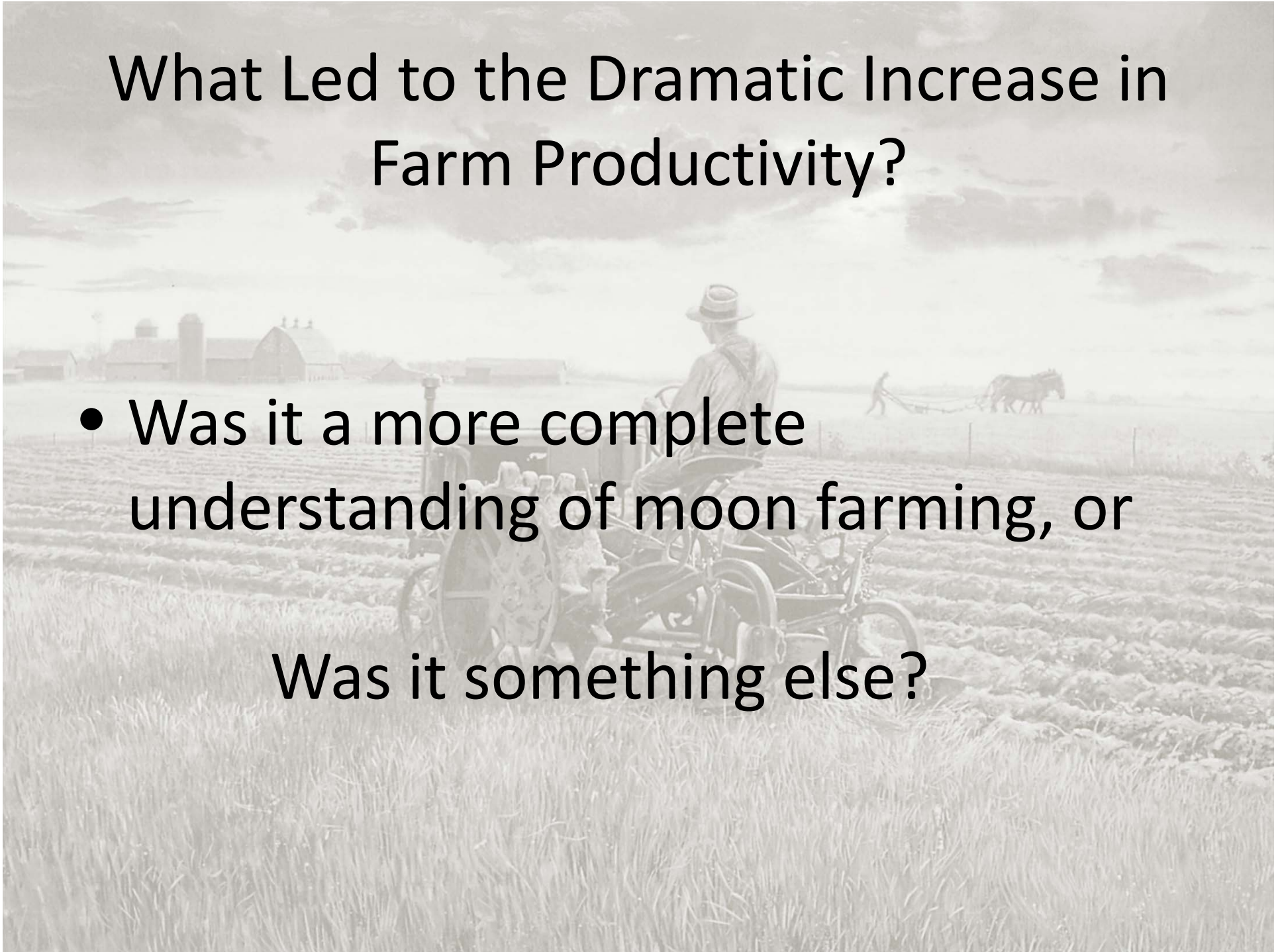
American Agriculture



What Led to the Dramatic Increase in Farm Productivity?

- Was it a more complete understanding of moon farming, or

Was it something else?



Top 10 Developments in Agriculture during the Past 100 Years

...with apologies to
Letterman



Prologue

- 1862 – Morrill Act
 - Established Agricultural Colleges
- 1887 – Hatch Act
 - Established Agricultural Experiment Stations



NORTH CAROLINA
AGRICULTURAL EXPERIMENT STATION,
—1885—
BULLETIN No. 1.
ANALYSES OF FERTILIZERS.

RALEIGH, N. C., March 28, 1885.

The following analyses of official samples of fertilizers have been completed at the Station since January 1st, 1885.

The valuations are only reatively correct; they are not intended to fix the price at what the articles are to be sold. In calculating them, available phosphoric acid was supposed to be worth 9 cts. per pound, ammonia 20 cts. per pound and potash 5 cts. per pound.

3165. Acme Fertilizer, Acme Manufacturing Co., Wilmington, N. C., sampled with A. B. Suttle, Shelby. Con-

Déjà vu

The Society helped to better American agriculture by introducing the idea of systematically conducting experiments to advance the level of agrarian technology, and then publishing the results. By constantly calling attention to the deficiencies of American husbandry and by developing ways of overcoming these conditions, the Society unquestionably aroused an interest in the improvement of farming methods. Suggestions of new techniques, whether of European or American origin, fell on more receptive ears because of the program of the Society.⁵²

Elsworth, L. F. (1968). The Philadelphia Society for the Promotion of Agriculture and Agricultural Reform, 1785-1793. *Agricultural History*. Vol. 42 No. 3

But There is a Problem!!!



- The teaching and research about agriculture was not making it out to the farmer!!

10. Federal Legislation Establishing Educational Programs for Farmers

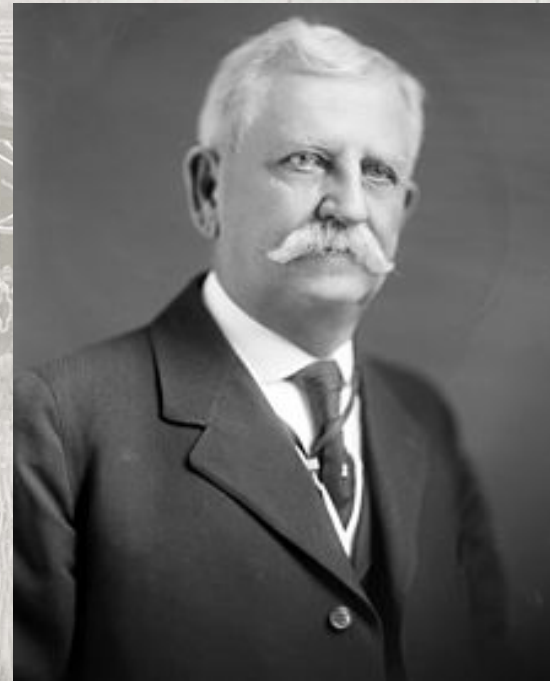
- Especially the Smith-Lever (1914) and Smith-Hughes Acts (1917)



Hoke Smith, GA



Asbury Lever, SC



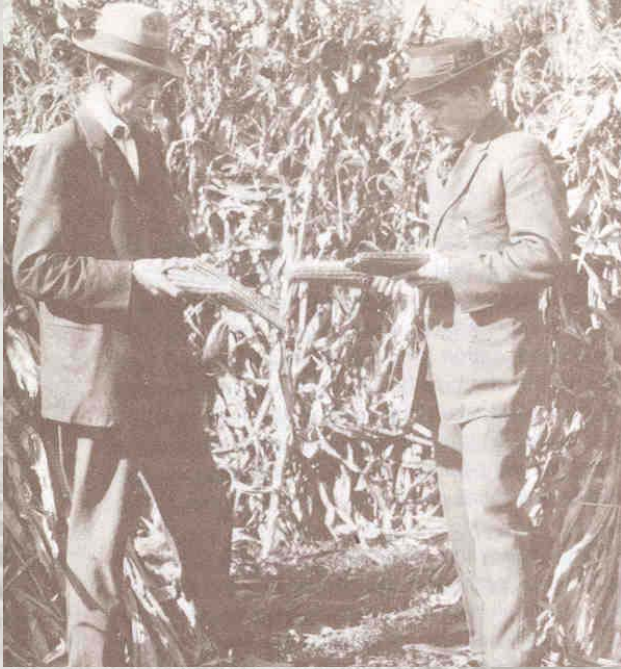
Dudley Hughes, GA

Educational Legislation

- Smith-Lever Act of 1914
 - Provided federal funding to support the Cooperative Extension Service
- Most counties in the US (in cooperation with land-grant colleges) had county agents who provided one-on-one and group instruction to
 - Farmers
 - Homemakers
 - Youth



Extension Activities

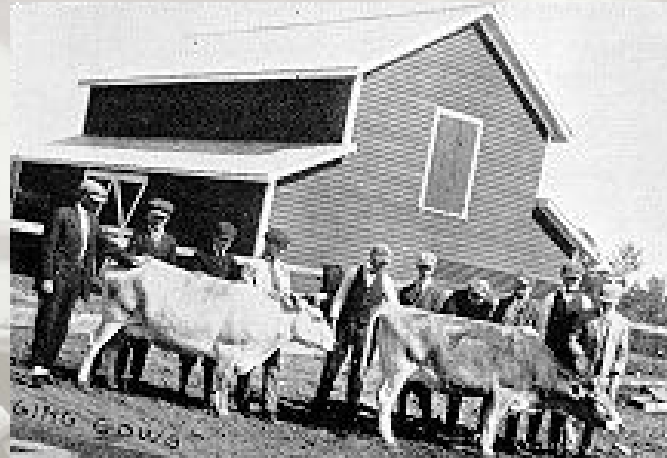


Educational Legislation



- Smith-Hughes Act of 1917
 - Provided federal funding to support the teaching of agriculture (and home economics) in the public schools
- Instruction was provided to both:
 - School Age Students
 - Adult Farmers

Agricultural Education Activities



Young Tarheel Farmers



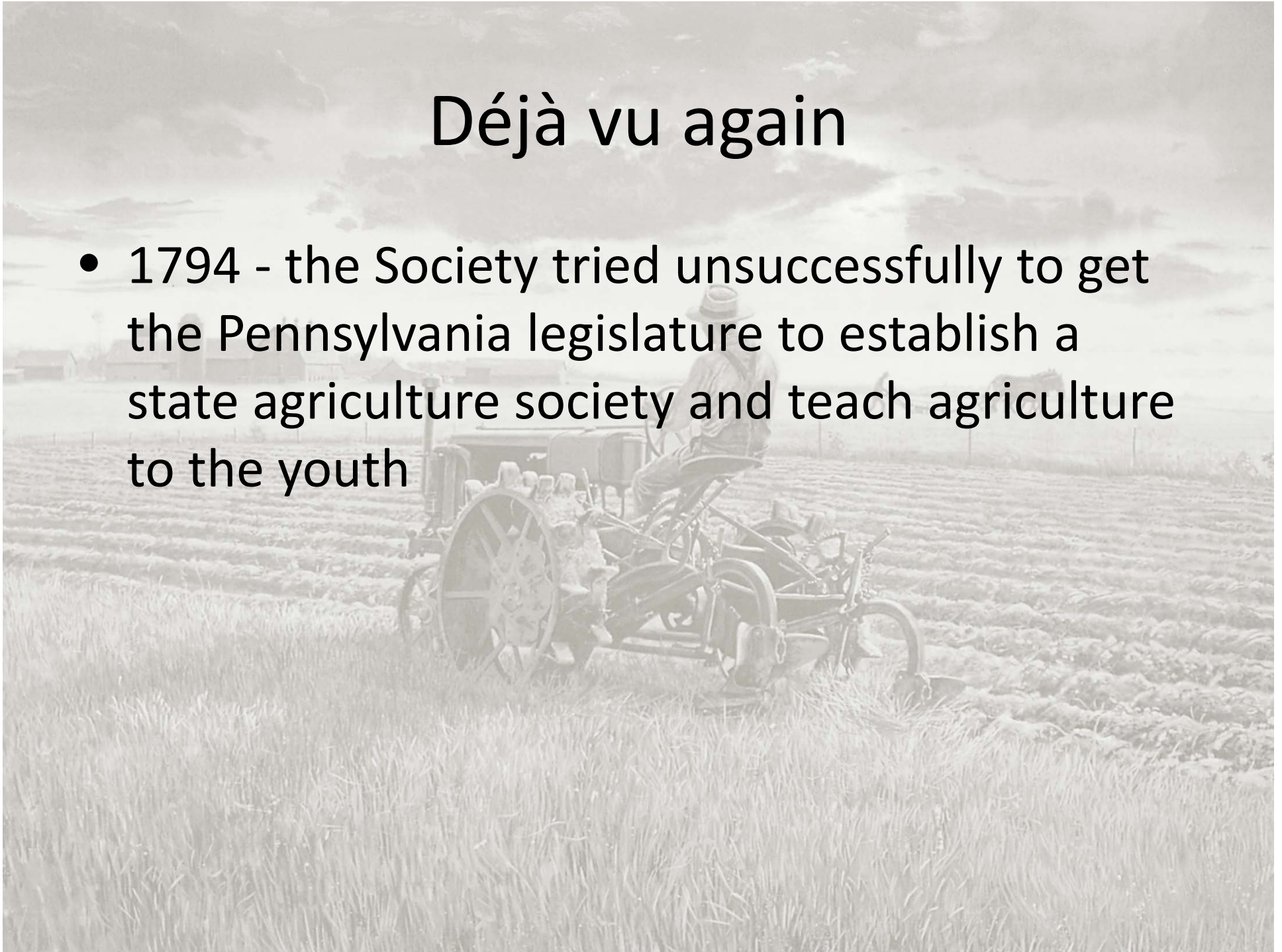
Educational Legislation

- Instruction by the agriculture teacher and the work of the extension agent did much to increase agricultural productivity all across the nation.
- FFA and 4-H programs developed leadership in rural youth and promoted the application of agricultural knowledge.



Déjà vu again

- 1794 - the Society tried unsuccessfully to get the Pennsylvania legislature to establish a state agriculture society and teach agriculture to the youth

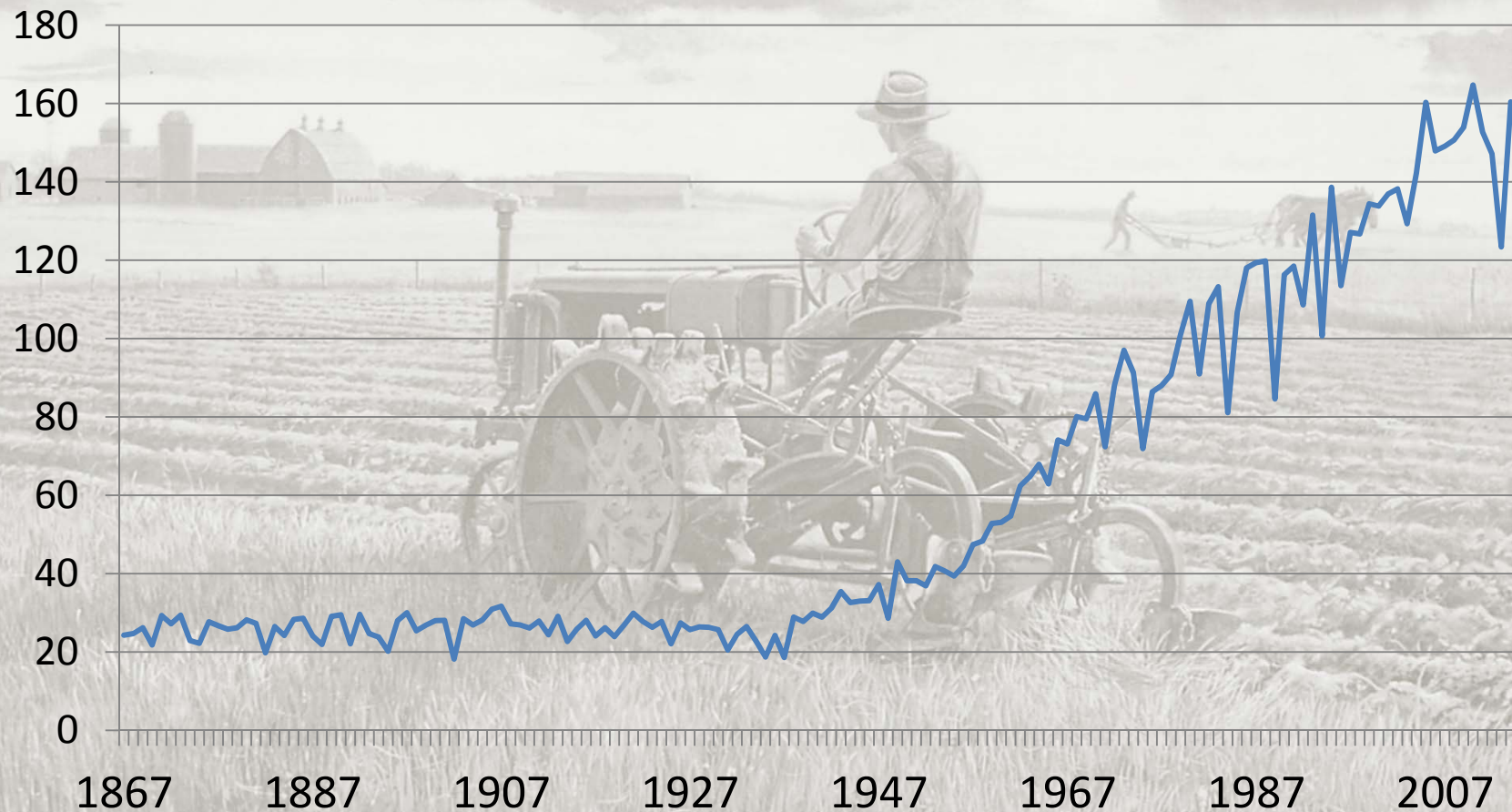


9. Crop Hybridization

Especially corn

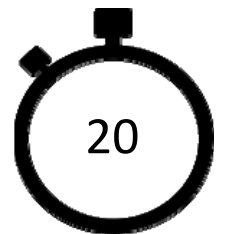
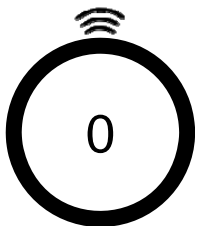


Corn Yield per Harvested Acre



In which state was the major work done on corn hybridization?

1. Illinois
2. Pennsylvania
3. Iowa
4. Indiana
5. Connecticut



Corn Hybridization

- Donald Jones - Connecticut Agricultural Experiment Station - 1919
- Developed a double-cross hybrid corn
- Hi-Bred Corn Company founded - 1926
- Sold the Cooper Cross Hybrid

Hybrid Corn has resulted in a 1.2 bushel increase in yield every year since its development.



Wheat Breeding

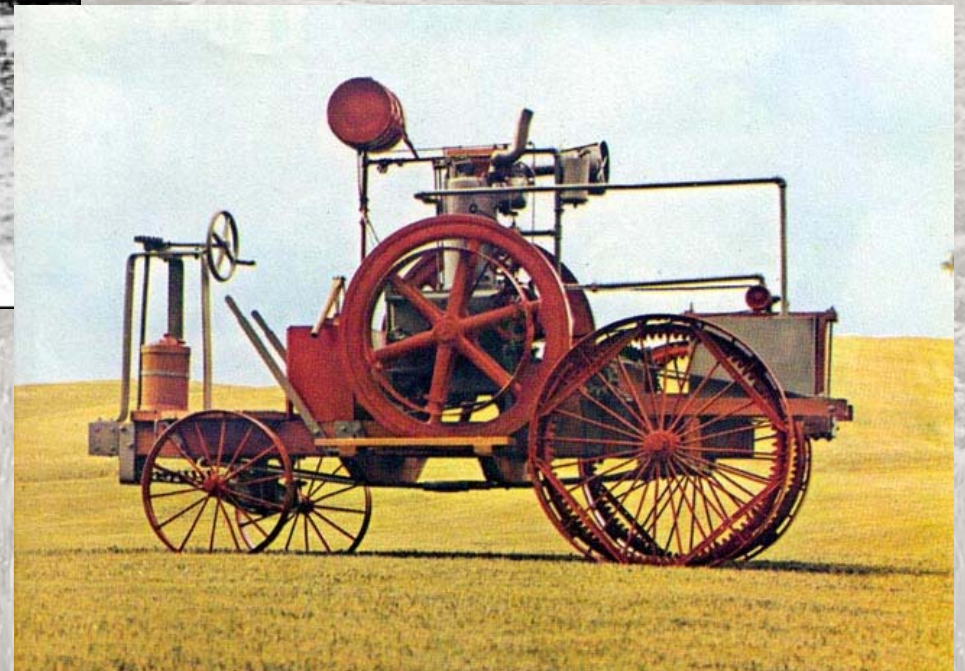
Similar gains were made with wheat breeding in the early 1900s



Footnote: In 1800 the PSPA proposed a premium:

“For the best comparative experiments on the culture of wheat, by sowing it in the common broad-cast way, by drilling it, and by setting the grain, with a machine, equidistant; the quantities of seed and produce proportioned to the ground, being noticed—a gold medal; for the second best—a silver medal.”

8. Internal Combustion Gasoline Powered Tractor



At the turn of the century farm labor was supplied primarily by humans and horses.



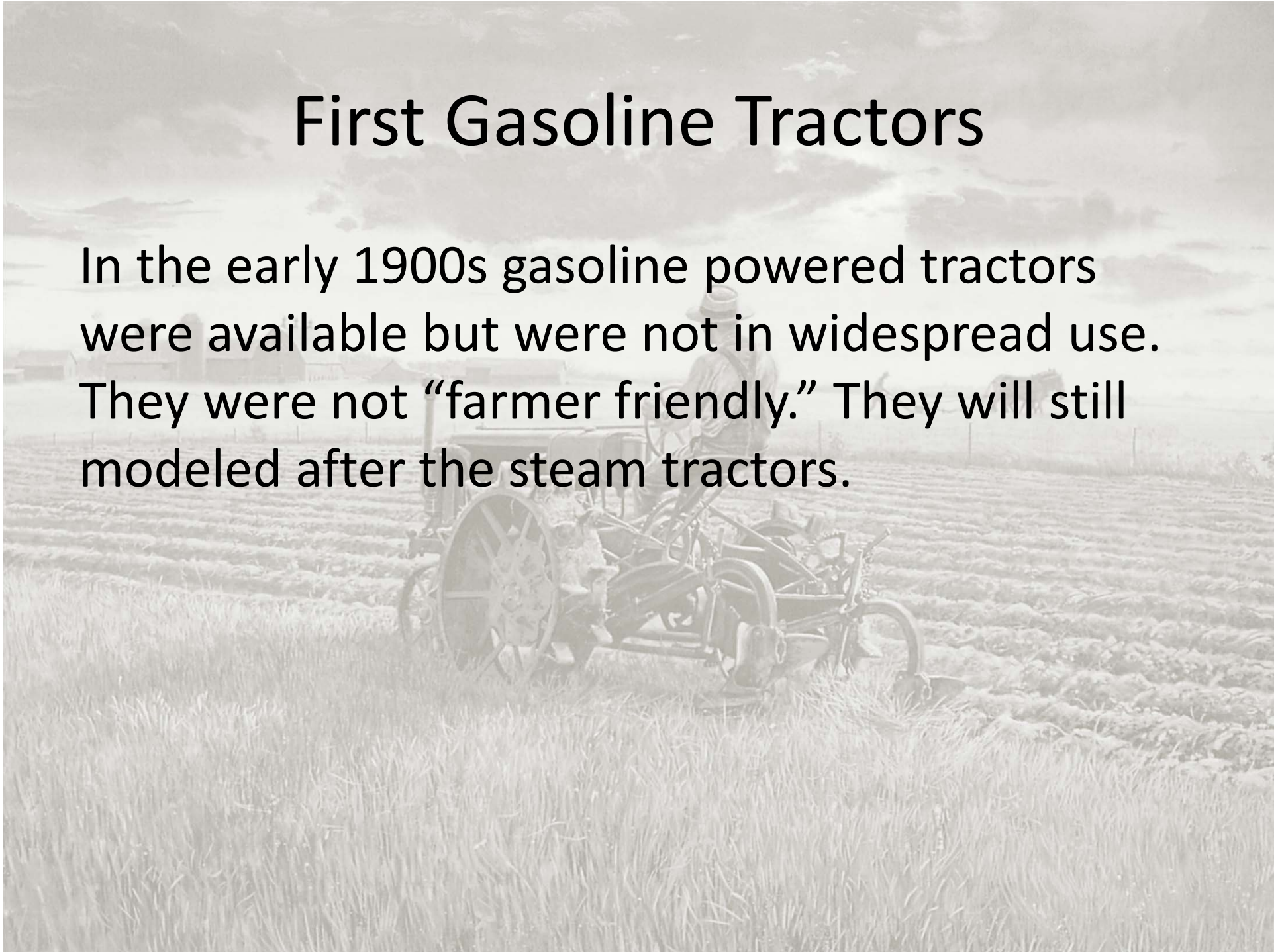
The Steam Tractor

In the early 1900s steam tractors provided power on the farm but required a crew to operate. Steam tractors were not in widespread use.



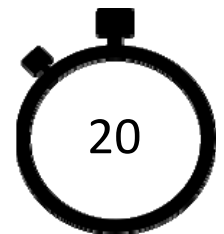
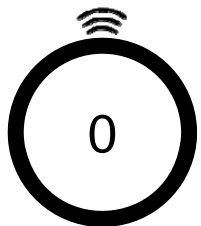
First Gasoline Tractors

In the early 1900s gasoline powered tractors were available but were not in widespread use. They were not “farmer friendly.” They will still modeled after the steam tractors.



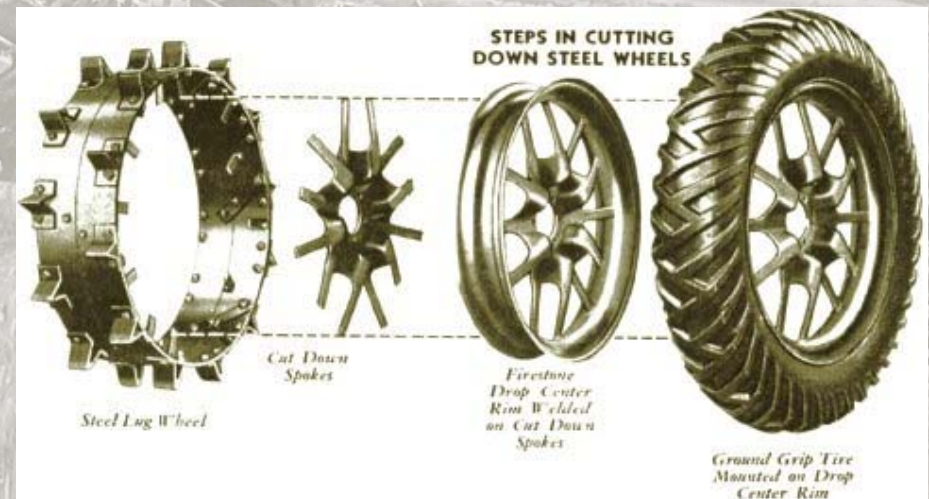
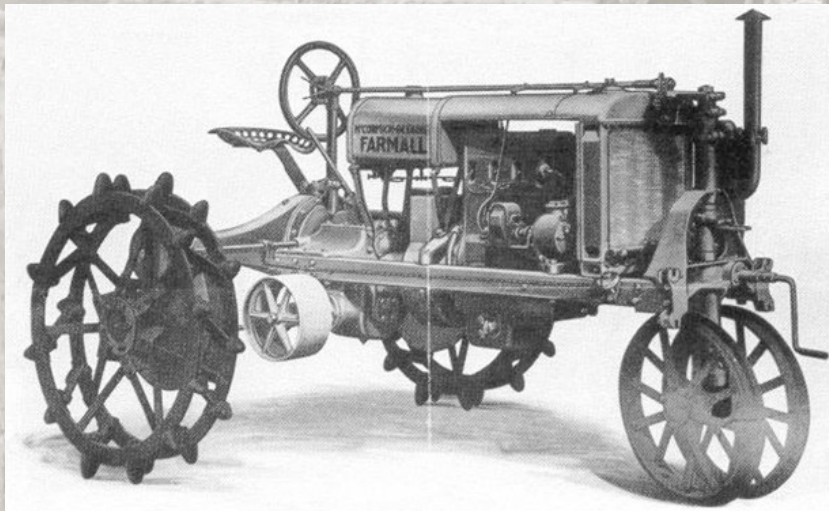
The first farmer friendly gas tractor was a:

1. Farmall
2. John Deere
3. Oliver
4. Fordson



The Breakthrough Tractor

1925 the first high-wheeled, row straddling FARMALL tractor was introduced.

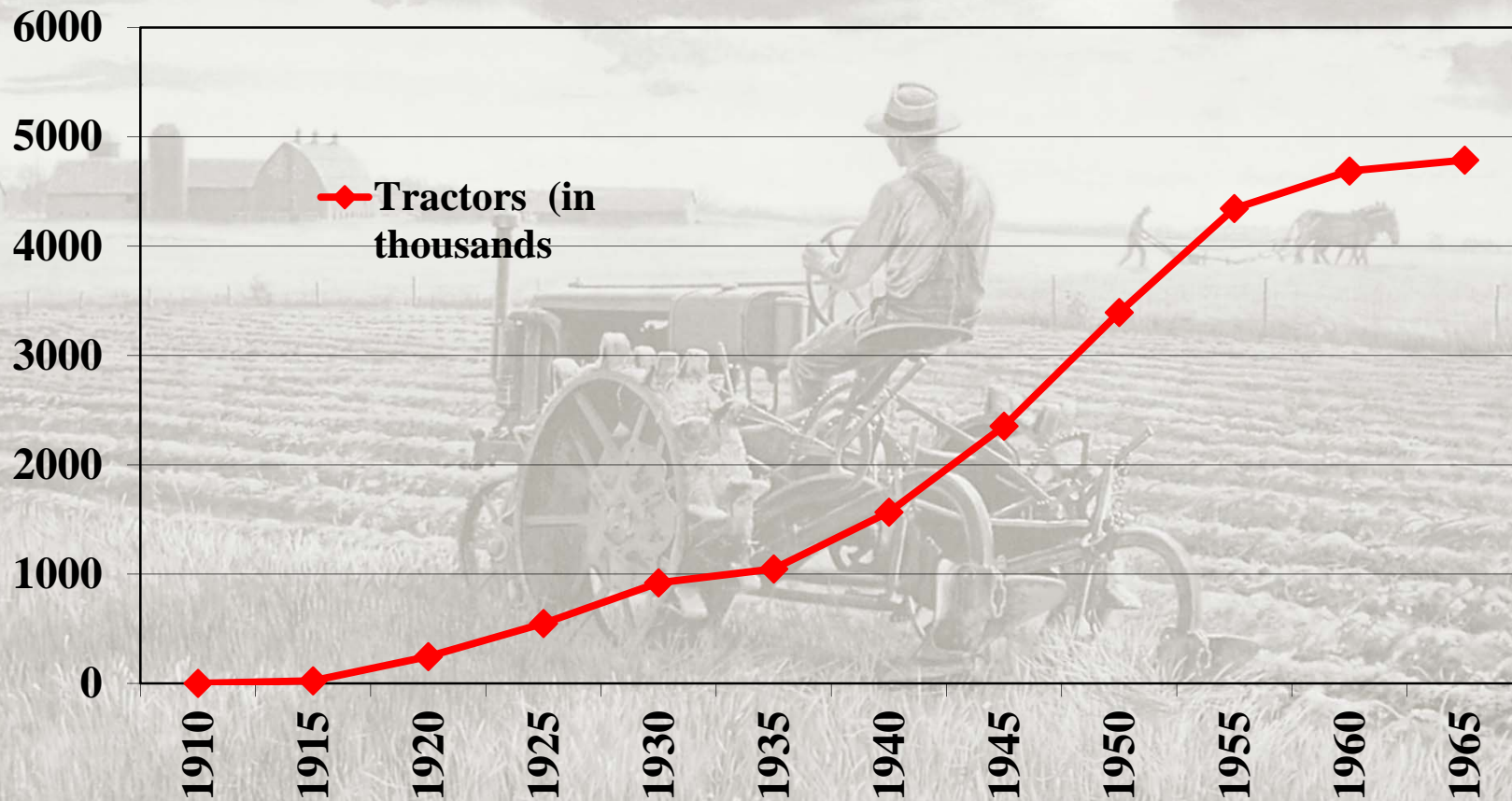


Tractor Accessories

- Bigger Plows
- Corn Pickers
- Combines

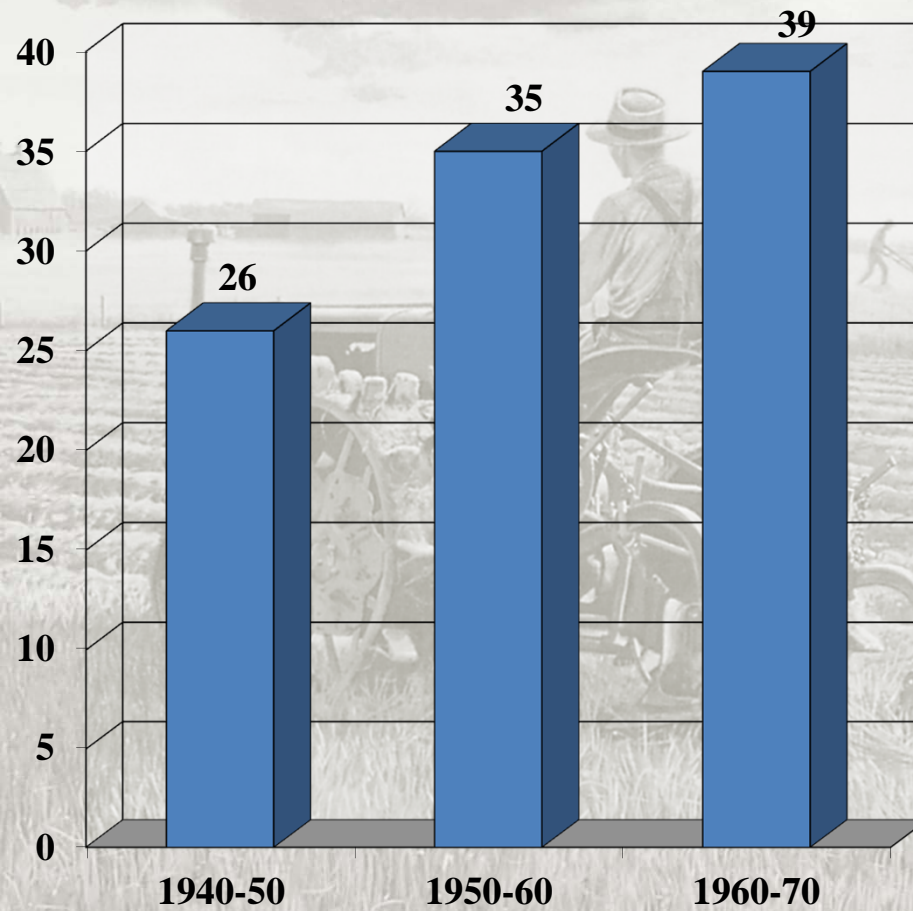


Growth in Tractor Numbers



In North Carolina it was not until 1956 that tractors outnumbered horses and mules for farming!

Reduction in Farm Labor

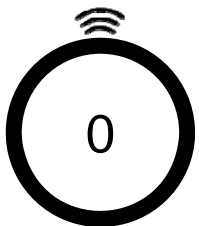


7. Farm Credit

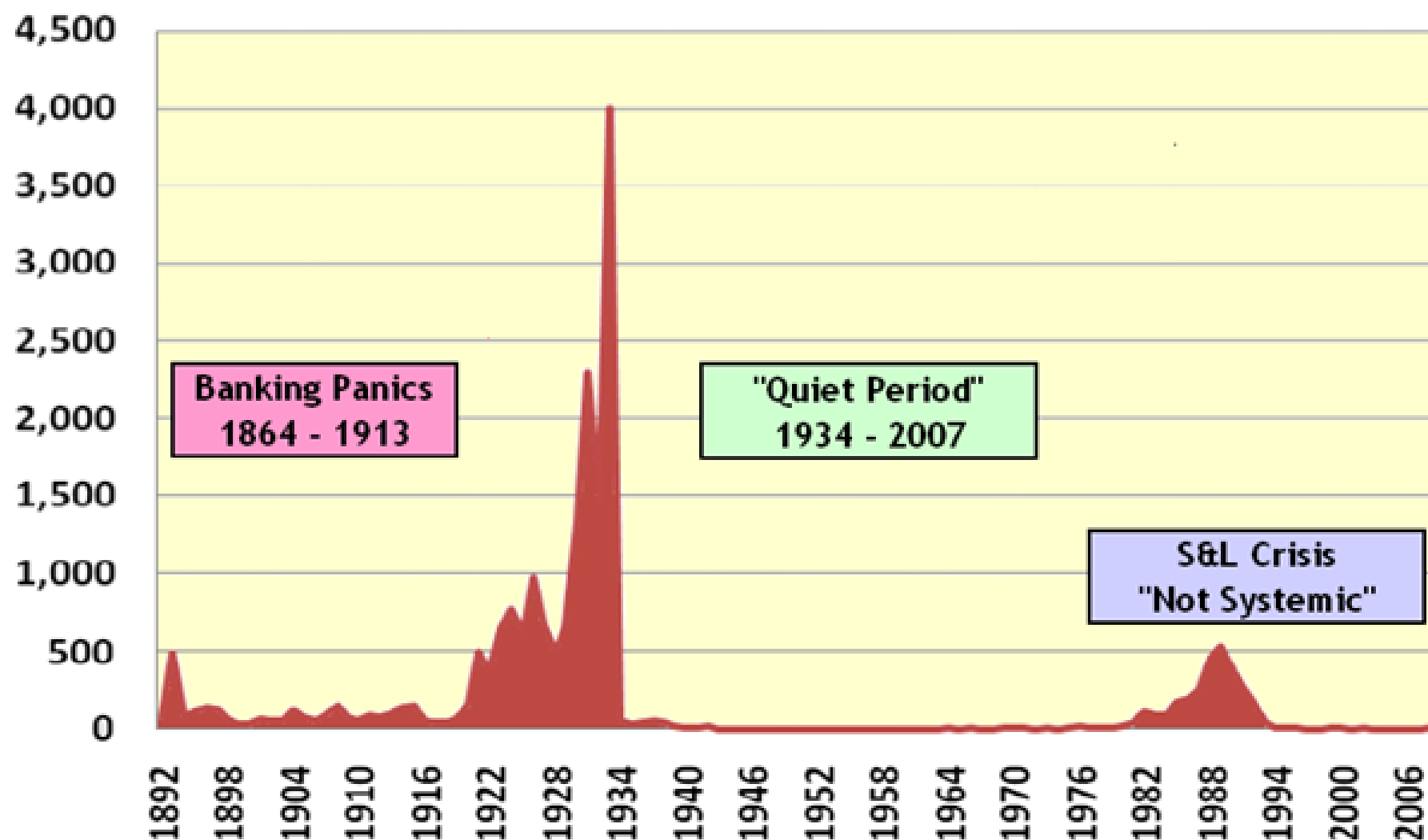


In which era was it nearly impossible
for a farmer to get a loan?

1. 1910-1918
2. 1920-1925
3. 1928-1934
4. 1940-1945
5. 1950-1957



Number of U.S. Bank Failures, 1892-2008



Source: G Gorton, Slapped in the Face by the Invisible Hand: Banking and the Panic of 2007; Banking and Monetary Statistics, FDIC.

A typical scene



Farm Credit

- A variety of federal policies and laws led to the development of a system of farm credit.
- Federal Credit Administration – 1916 & 1932
- Federal Land Bank – provide low interest loans to farmers to buy land
- Production Credit Associations – 1933
 - Provide low interest loans to farmers for farming operations



Farm Credit

6. Soil Conservation Service



*Sunday April 14, 1935
Dust Clouds Rolling Over The Prairies
Storall Studio, Dodge City, Kansas # 5*





PSPA – July 1785

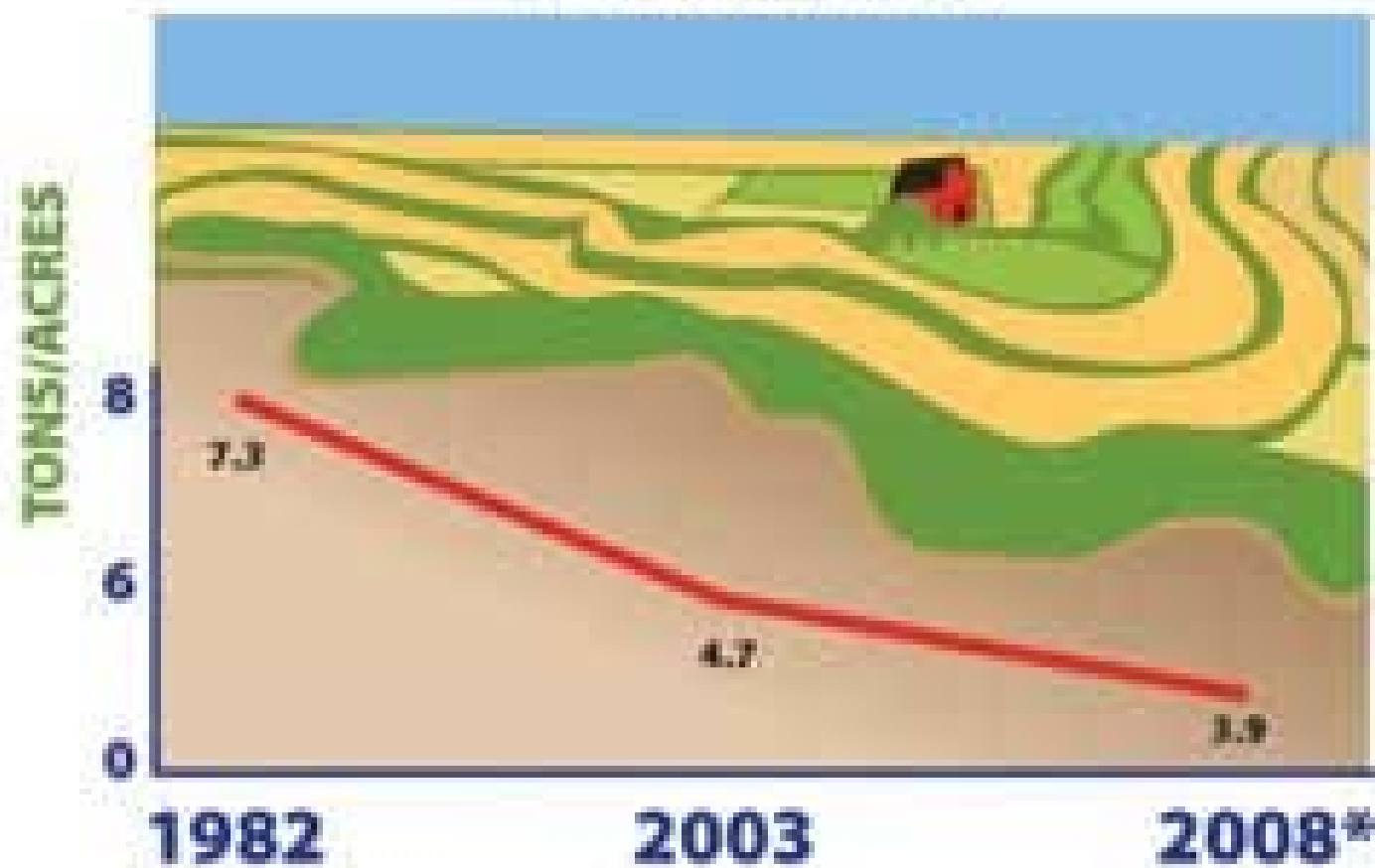
- Three major objectives were suggested
 - 1. Encourage use of oxen instead of horses
 - 2. Promote soil conservation
 - "For the recovery of gullied and worn-out fields;" and suggests that "where such fields are so gullied as to be irrecoverable for the purposes of tillage, they may be applied to the growth of various kinds of timber."
 - 3. Encourage the planting of hedgerows

Soil Conservation

- During the early part of the 1900s, especially during the 1930s, soil was eroding at an alarming rate in the south.
- It was blowing away in the Midwest and West.
- The establishment of the Soil Conservation Service in 1933 was a major milestone in saving our soil.

SOIL EROSION IN DECLINE

Wind and Water



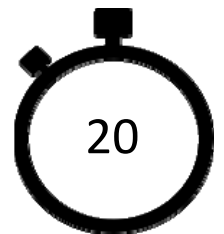
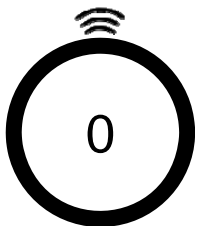
5. Artificial Insemination (AI)

I don't like
that idea!

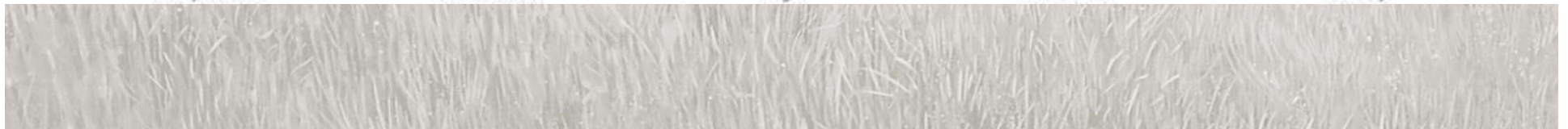
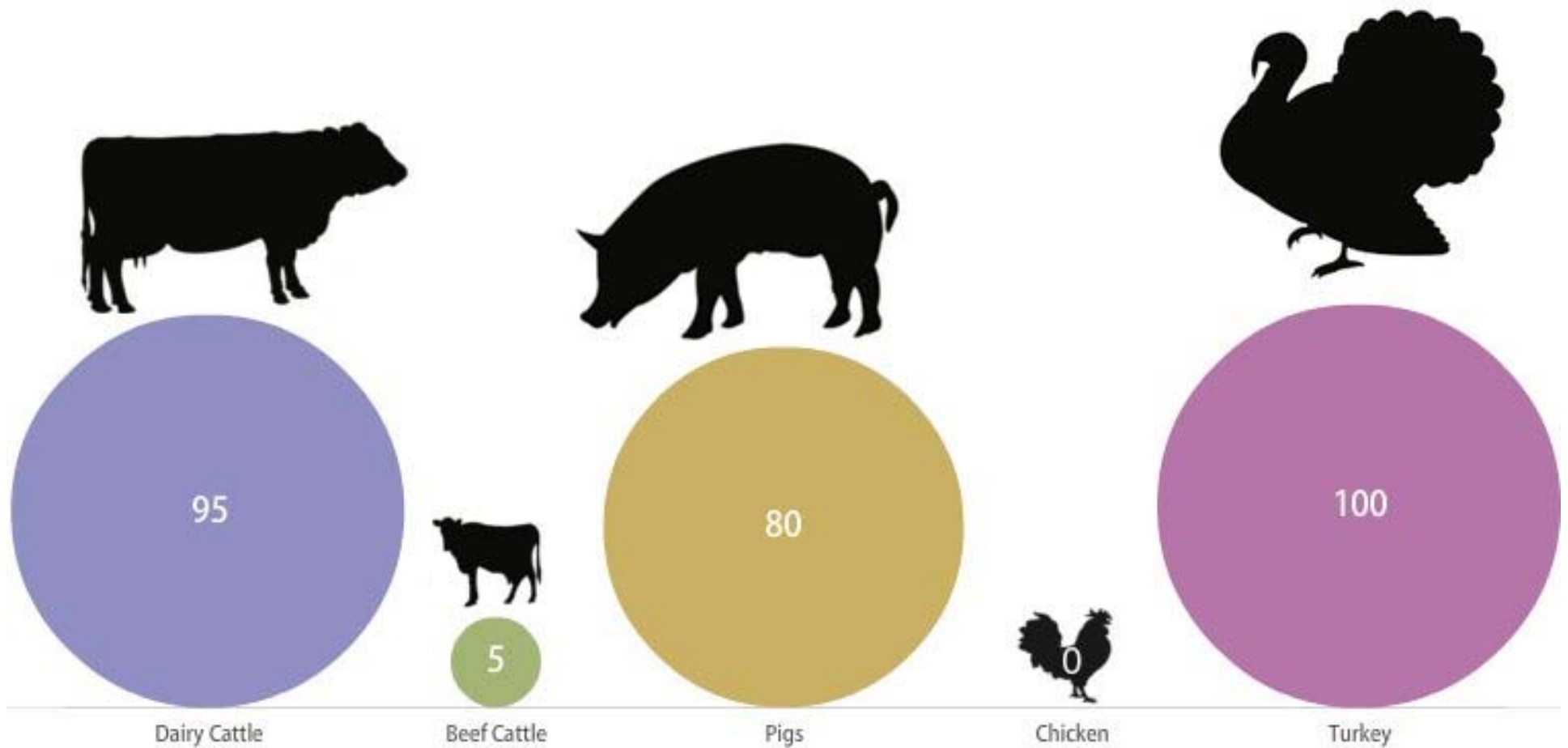


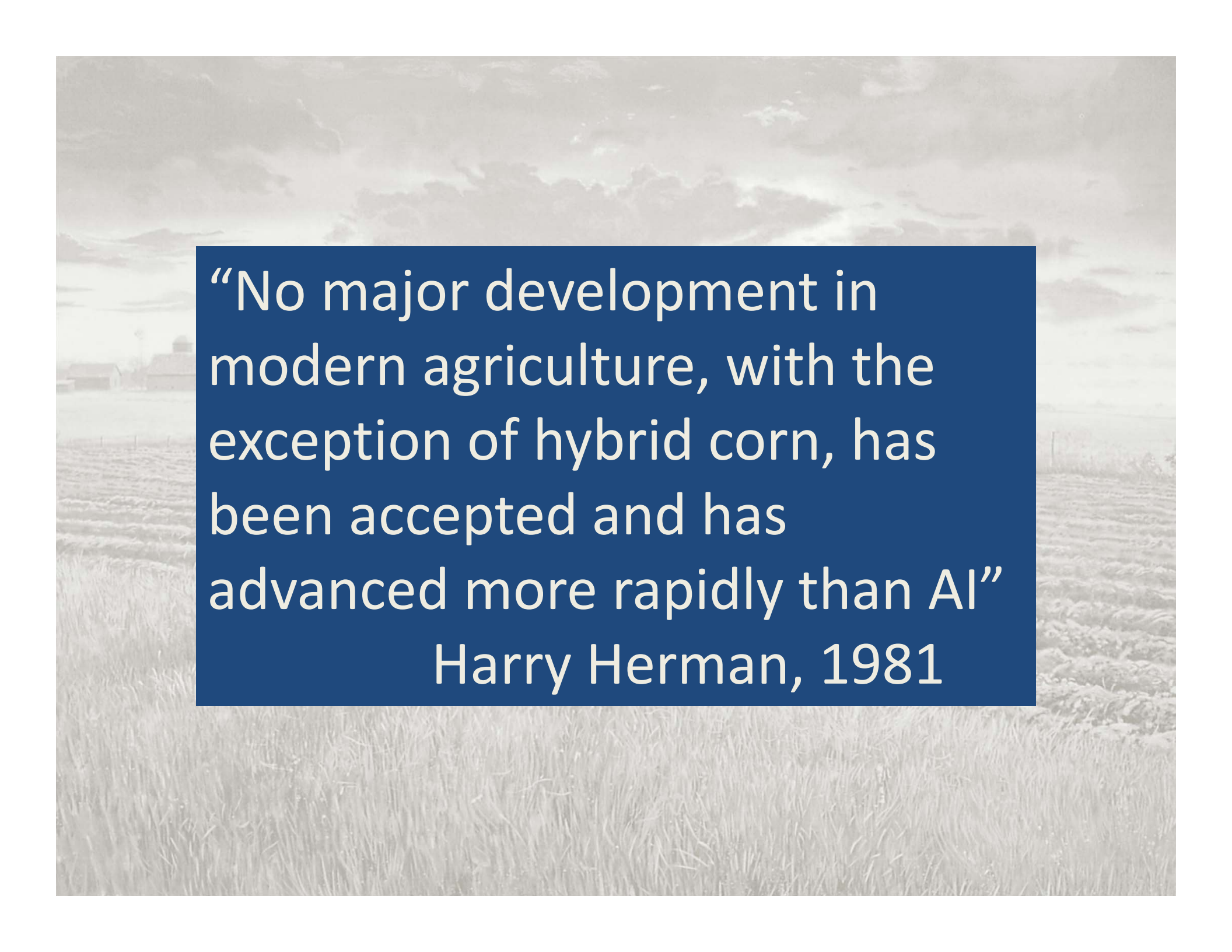
Which species is Artificial Insemination
used the **least** on?

1. Dairy Cattle
2. Turkeys
3. Swine
4. Beef Cattle



The AI Data





“No major development in modern agriculture, with the exception of hybrid corn, has been accepted and has advanced more rapidly than AI”

Harry Herman, 1981

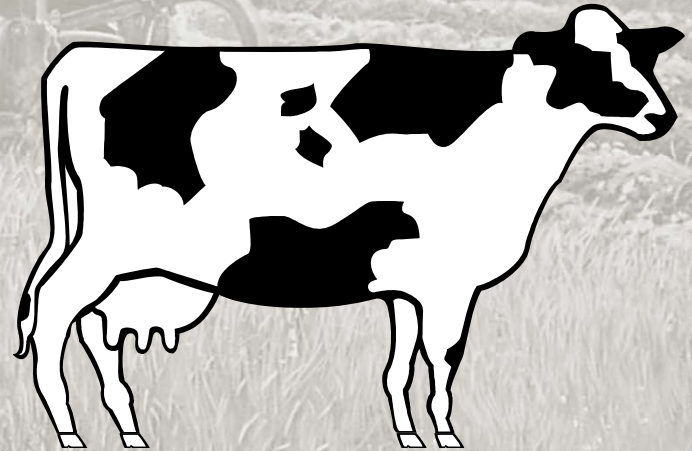
AI is not new

- Arabians used it with horses in the middle ages
- In the 1780s Spallanazani was using it with dogs in Italy
- Much of the initial work with dairy cows was done in the 1930s in New Jersey and Minnesota



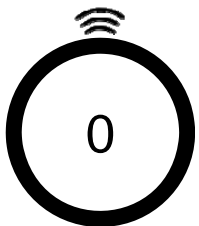
Today

- Majority of dairy cows are bred using AI
- Major gains in feed efficiency, milk production, average daily gain, etc. can be attributed to selective breeding through AI.



By 1930 what percent of the farms had electricity?

1. 10%
2. 23%
3. 38%
4. 52%
5. 70%



4. Rural Electrification

- By 1930, 70% of the urban population had electricity.
- By 1930, 10% of the rural population had electricity.



4. Rural Electrification

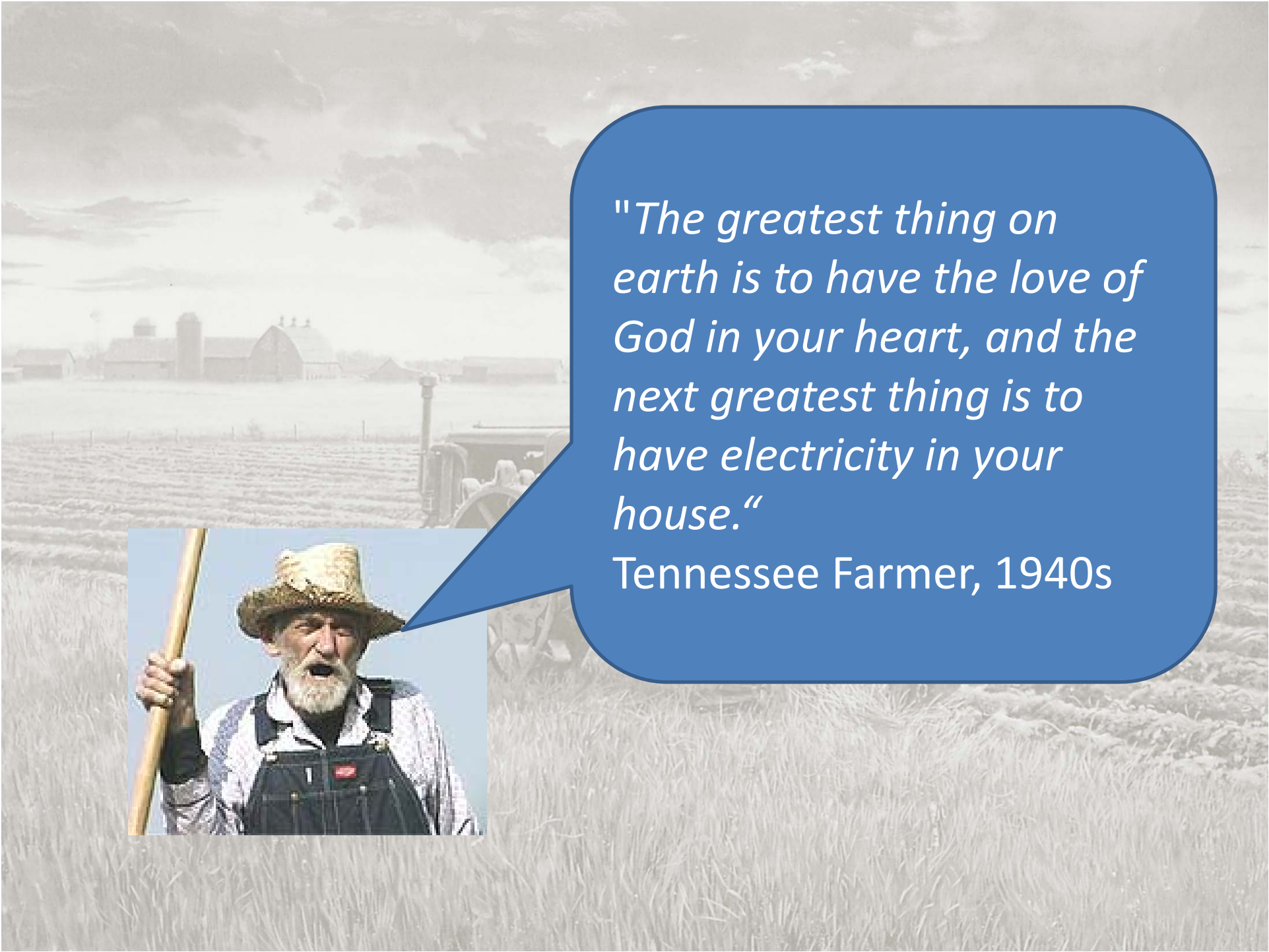
- 1935 – Rural Electrification Administration (REA) created
- Magazines like the "Electric Farmer" and "Electricity on the Farm" published articles with hints about using the new power for farmwork and housework.
- Dairy farmers learned how electric milking machines would increase the speed of their work.
- Farm wives learned how electric stoves, washers, and water heaters could improve their home.
- Electric pumps also made indoor plumbing a reality for farm families.

A Poem

Electricity is a servant, make it work for you.
Then baking days won't be so hot, or washdays be so blue.
Your cows will be contented, with a milker fine and bright.
The kids will like the music, from the radio at night.
Your feed will be ground easily, your baby chicks kept warm.
The whole family will be happy, with electricity on the farm.

--Author Unknown





"The greatest thing on earth is to have the love of God in your heart, and the next greatest thing is to have electricity in your house."

Tennessee Farmer, 1940s



By 1950, 93% of farms had electricity.



AMERICAN COMMEMORATIVES



Rural Electrification Administration

For 50 years the Rural Electrification Administration (REA) has helped provide electric power to homes and farms in areas once thought too remote to be served economically. Before electrification, rural life in America was usually far from the tranquil paradise many assumed it to be. A succession of bad seasons could wipe out a lifetime of caring for the land. Because of the hardships, many young people moved to the cities in search of modern conveniences.

President Franklin Delano Roosevelt created the REA in 1935 to provide low-interest loans to establish consumer-owned electrical cooperatives in regions where public or private utilities did not operate. Now a part of the Department of Agriculture, the REA has provided nearly \$60 billion in loans and has brought electrical power into the homes of nearly 12 million people.

Electricity did not solve all of rural America's problems, but it eased workloads and raised the standard of living closer to that enjoyed by urban dwellers. Electricity lighted homes and barns, and powered machines that washed clothes and stored food safely. Indoor plumbing was made possible in rural areas through electric pumps and water heaters. Electricity also brought the radio as a direct link between farms and the rapidly changing outside world. Today, electricity reaches 99 percent of all rural residents, and has played a key role in building the U.S. agriculture industry into the most productive in the world.

The engravings above, depicting two sources of electricity, were produced in the early 1900's for use on negotiable certificates.

Commemorating 50 years of rural electrification, this stamp was designed by Howard Koslow of East Norwich, New York, and was issued on May 11, 1985, in Madison, South Dakota.



Stamps printed by the Bureau of Engraving and Printing, Washington, D.C.

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No. 742 in a series

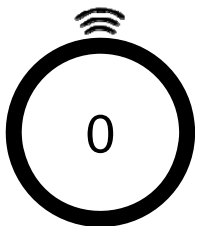
May 11, 1985 / Printed in U.S.A.

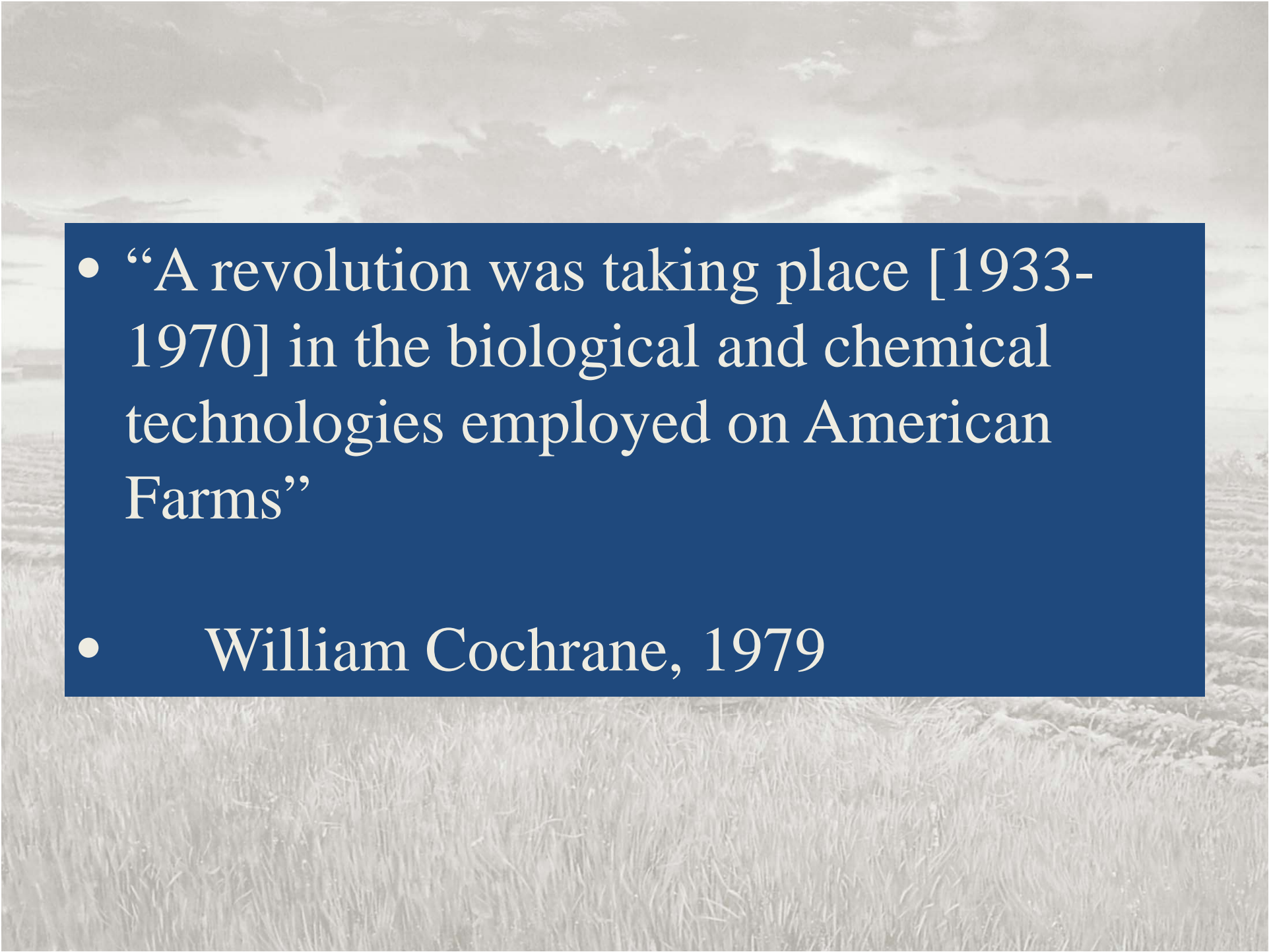
3. Agricultural Chemicals



What event primarily ushered in the age of agricultural chemicals?

1. World War I
2. World War II
3. Korean War
4. Viet Nam War



- 
- “A revolution was taking place [1933-1970] in the biological and chemical technologies employed on American Farms”
 - William Cochrane, 1979

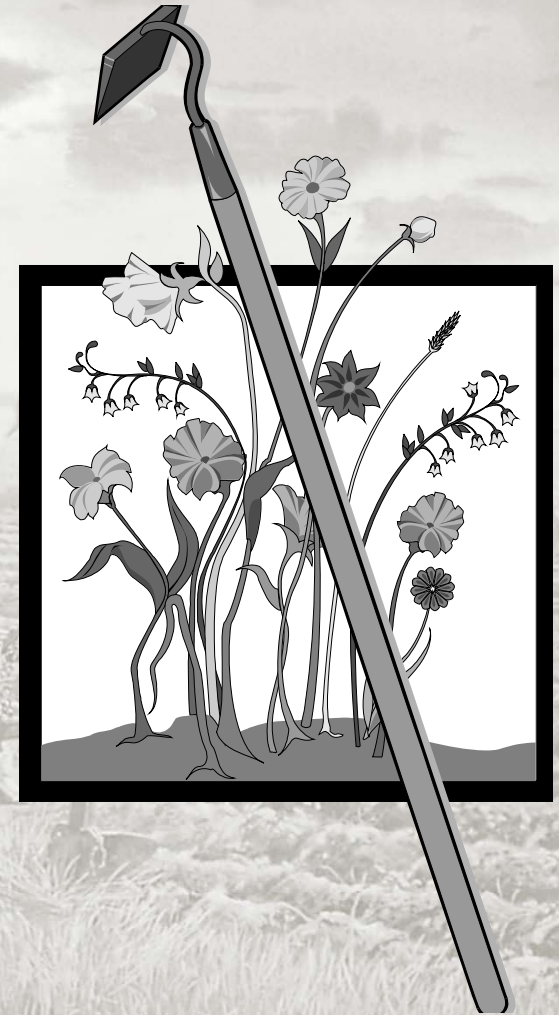
Pesticides

- DDT was developed in Switzerland in 1939
- Came to the US in 1942
- Controlled a wider range of insects than any known insecticide
- DDT could be dusted, sprayed or dipped
- Other hydrocarbon insecticides followed:
 - Chlordane (1945)
 - Aldrin (1948)
 - Dieldrin (1948)
 - Heptachlor (1948)



Herbicides

- Chemical warfare research led to the development of:
 - 2,4-D (1942)
 - 2,4,5-T (1945)
- After 1945 back-breaking hoeing and the need for extensive cultivation diminished



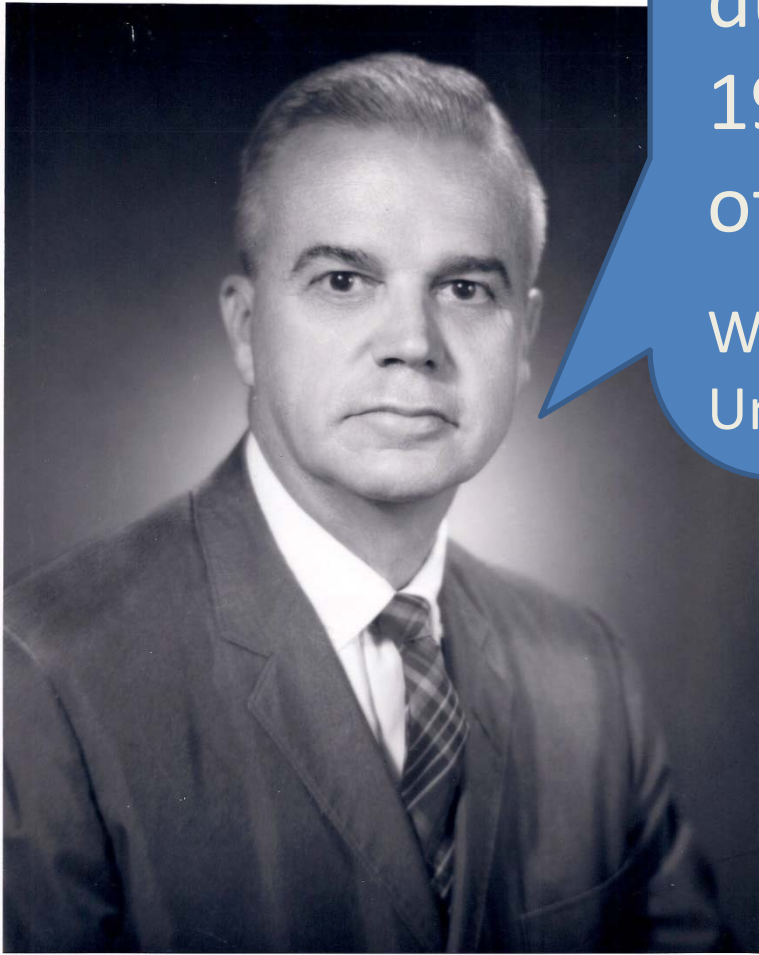
Fertilizers

- Anhydrous Ammonia emerged after WWII
- It was cheap and took little labor to apply
- The amount of nitrogen (and potash) applied to crops between 1940 and 1970 increased **20X**



“The greatest source of increasing yields per acre during this period [1933-1970] was the increased use of commercial fertilizers”

William Cochrane, 1979
Univ of MN, Applied Economics

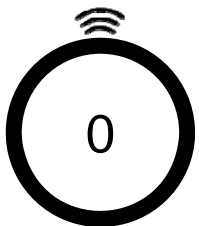


2. Biotechnology



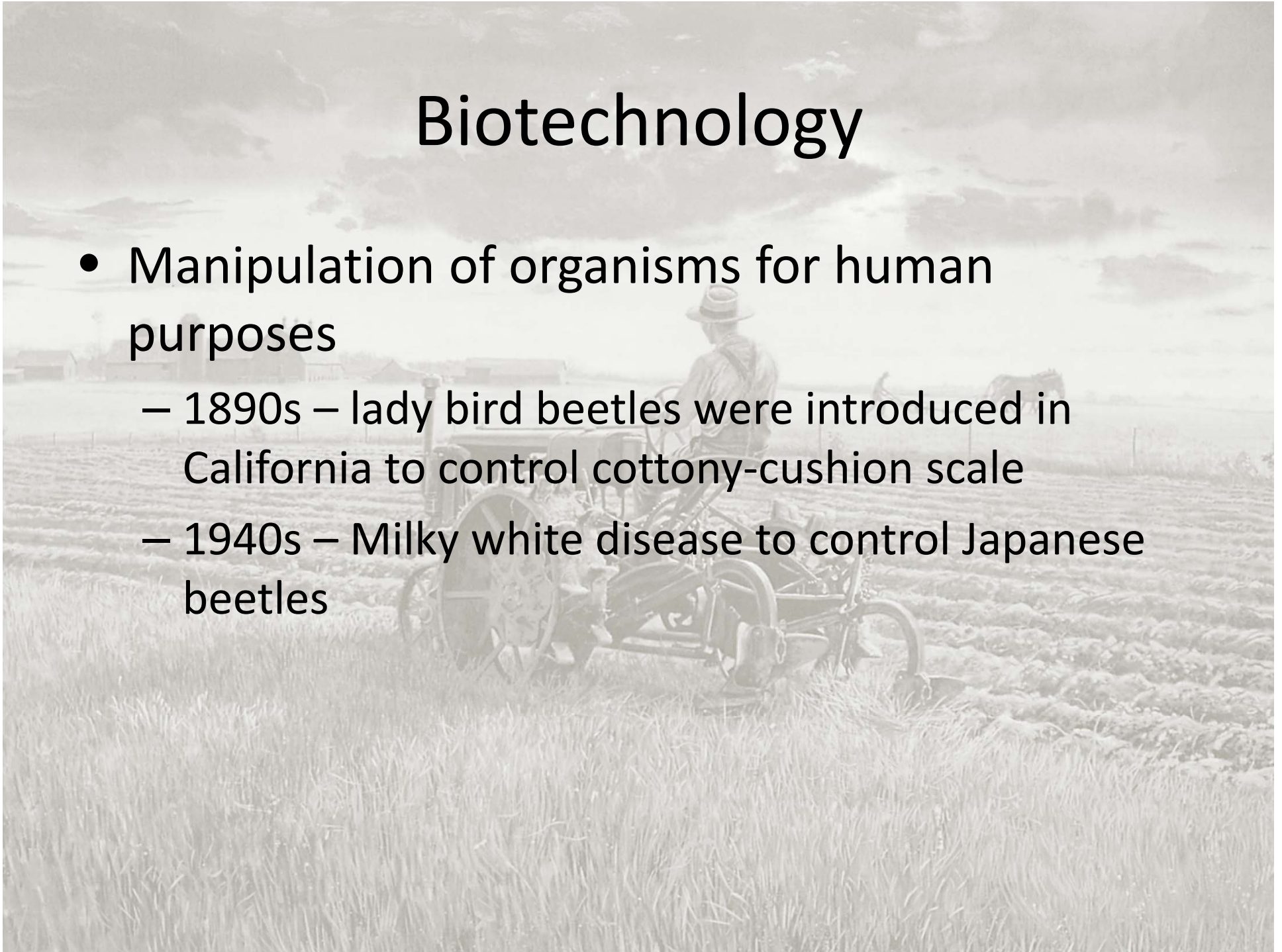
Which DOES NOT use biotechnology?

1. Production of Insulin
2. Production of Beer
3. Production of Cheese
4. All of the above use biotechnology
5. None of the above use biotechnology



Biotechnology

- Manipulation of organisms for human purposes
 - 1890s – lady bird beetles were introduced in California to control cottony-cushion scale
 - 1940s – Milky white disease to control Japanese beetles



Modern Successes

Screwworm

- Fly lays eggs on animal wounds
- emerging larva feed on the host animal
- Females only breed once
- Sterilize males through radiation
- Release sterilized males in infested areas
- By 1966 screw worm flies in the US were bred out of existence



In 1787 the PSPA was also very concerned with a fly – The Hessian Fly

Other Examples

- Artificial Pheromones
 - attracts insects to baits
 - disrupts sex life
 - draws insects away from crops
- Parasitic wasps
- Biopesticides



DNA



1869 – DNA was first discovered

1953 – Watson and Crick
discovered the structure of DNA

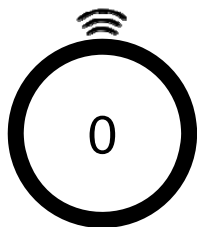
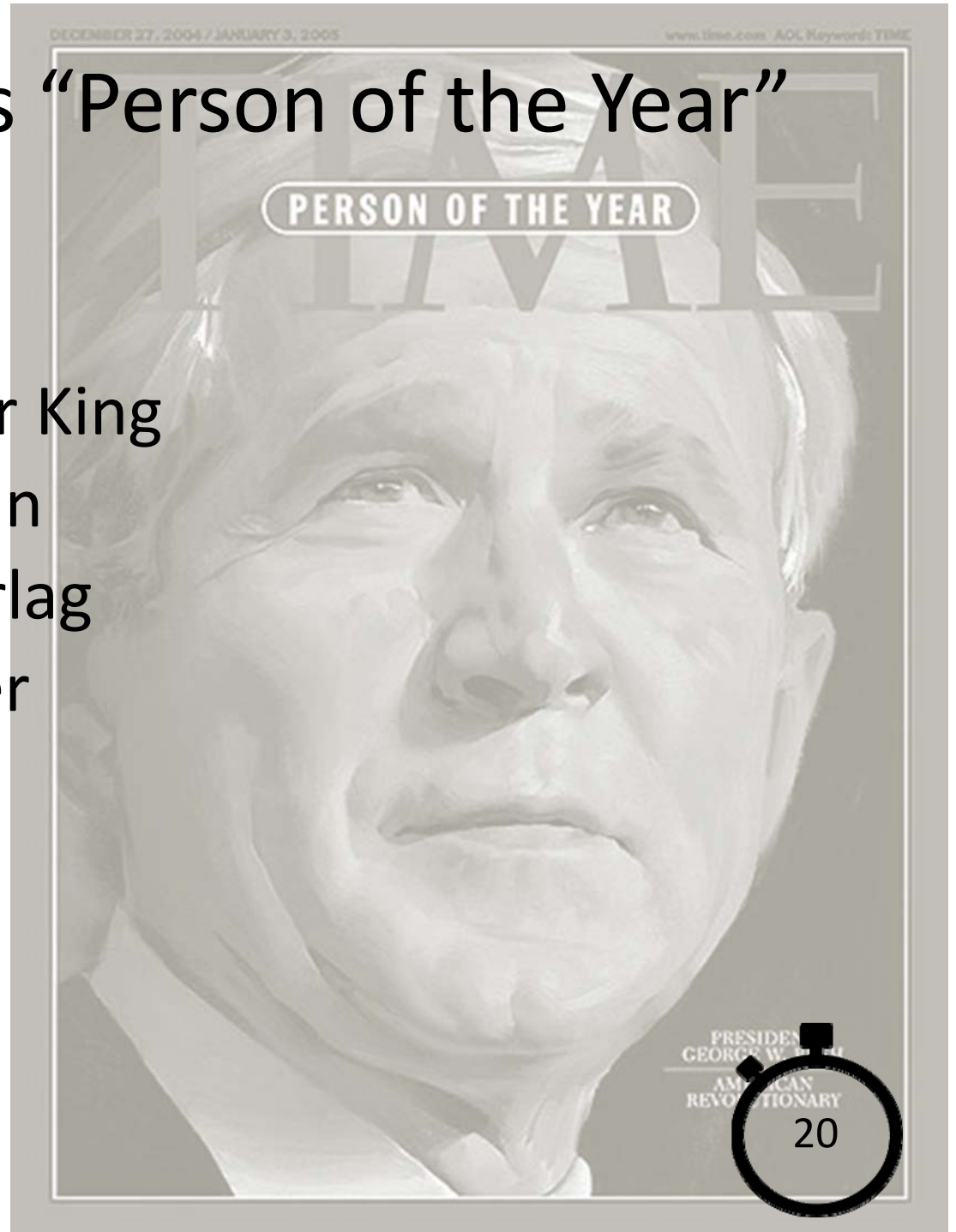
1970s-present – splicing genes, removing genes,
gene manipulation

Genetic Engineering (GMOs)

- Herbicide tolerant plants
- Insect resistant plants
- Vegetables and fruits with improved flavor, longer shelf life, later ripening
- Pharmaceutical producing plants
 - Potato with cholera prevention properties
 - Golden Rice
 - Half of the world's population subsist on 1 bowl of rice a day
- Livestock cloning

Time Magazine's "Person of the Year" in 1982 was

1. Lech Walesa
2. Martin Luther King
3. Ronald Reagan
4. Norman Bourlag
5. The Computer



1. Development of Computers



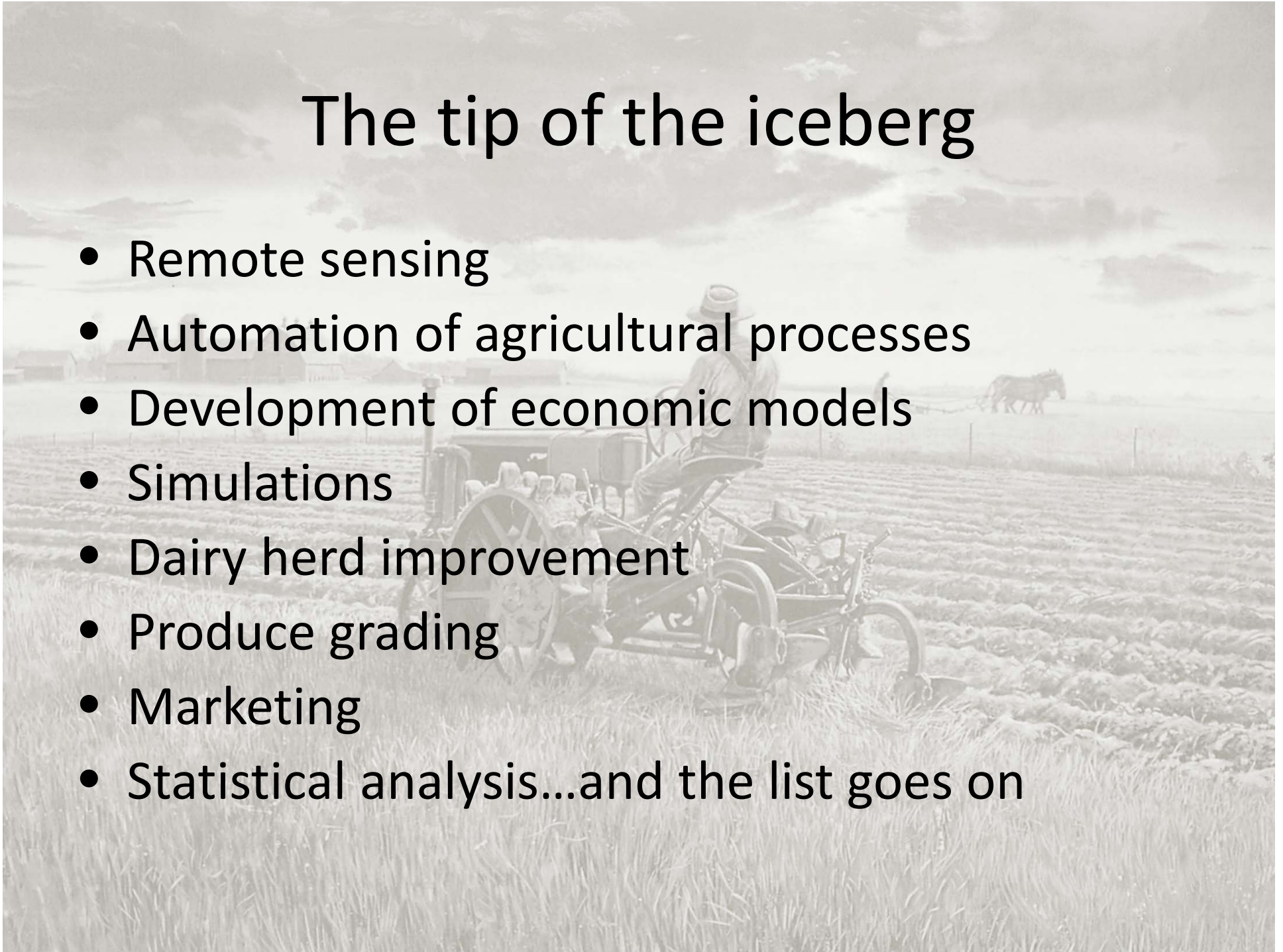
Computers

- In 1982 Time Magazine named the Computer “Man of the Year”
- Computers have had a major impact on how agricultural scientist and farmers do their work.



The tip of the iceberg

- Remote sensing
- Automation of agricultural processes
- Development of economic models
- Simulations
- Dairy herd improvement
- Produce grading
- Marketing
- Statistical analysis...and the list goes on



Then and Now

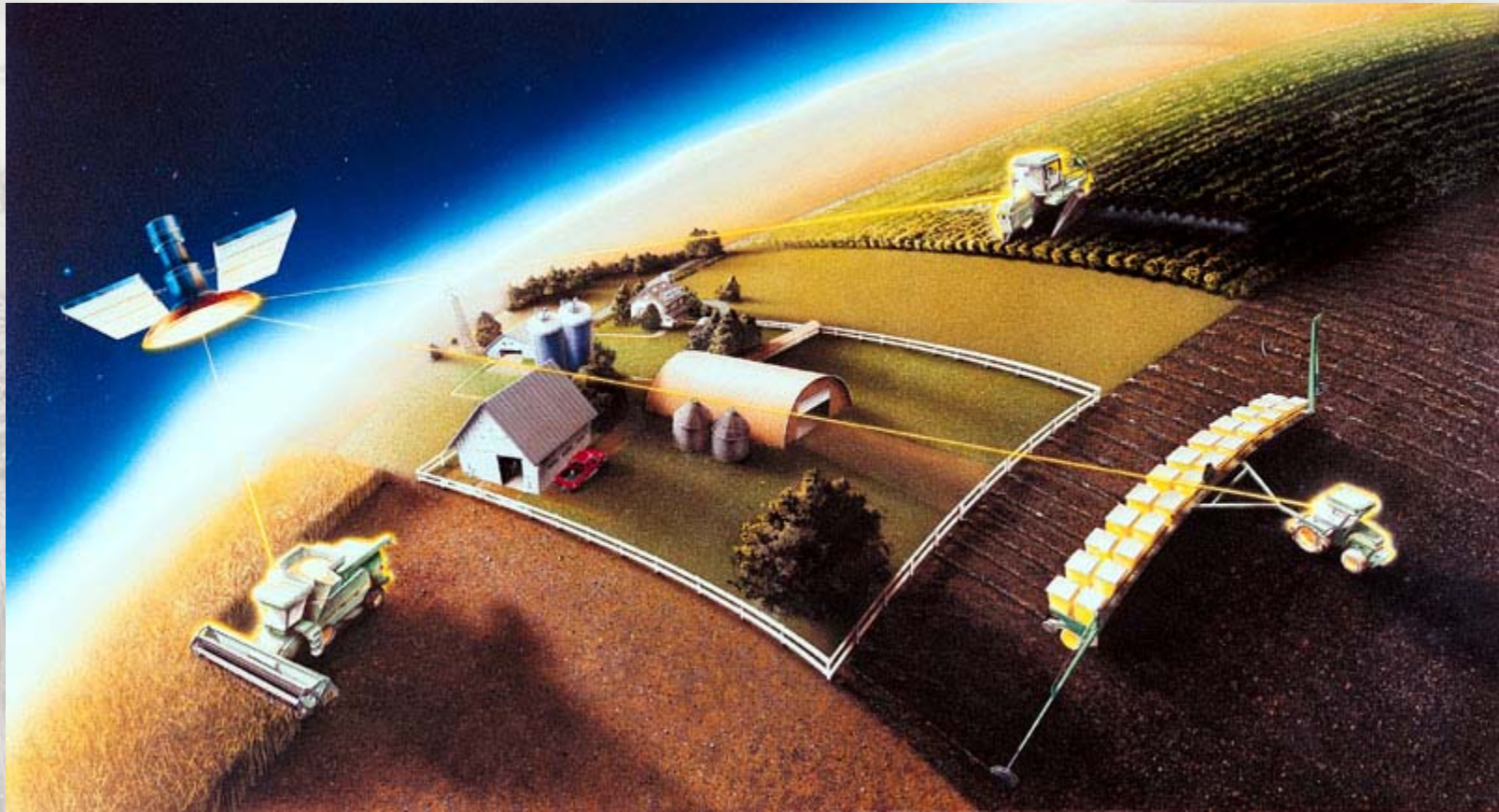
- “The Philadelphia Agricultural Society, through its varied activities, helped to lay the foundation for the first American agricultural revolution.” p. 199
 - Elsworth, L. F. (1968). The Philadelphia Society for the Promotion of Agriculture and Agricultural Reform, 1785-1793. *Agricultural History*. Vol. 42 No. 3
- “Agricultural scientists, agricultural educators and various federal laws and policies have been responsible for the current American agricultural revolution.”
 - Gary Moore, Professor of Agriculture, North Carolina State University

The Next 100 Years

- The Top Ten Innovations/Issues in Agriculture



1. Satellite Farming



Precision Farming

- On-the-go sensors, yield monitors, and geographically referenced databases in tractors are used to control:
 - seeding
 - Fertilizer application
 - Herbicide application
- Each square yard of a field can be managed according to its unique characteristics utilizing GPS and GIS technology



- Today's tractor has more computer power in the cab than the first moon shot!



Farmers in Maine

- A satellite 12,000 miles above the earth steers this tractor in a straight line across the field (the farmer does not have hands on the steering wheel), and computers on board plants a potato every 8 inches apart at the same depth.



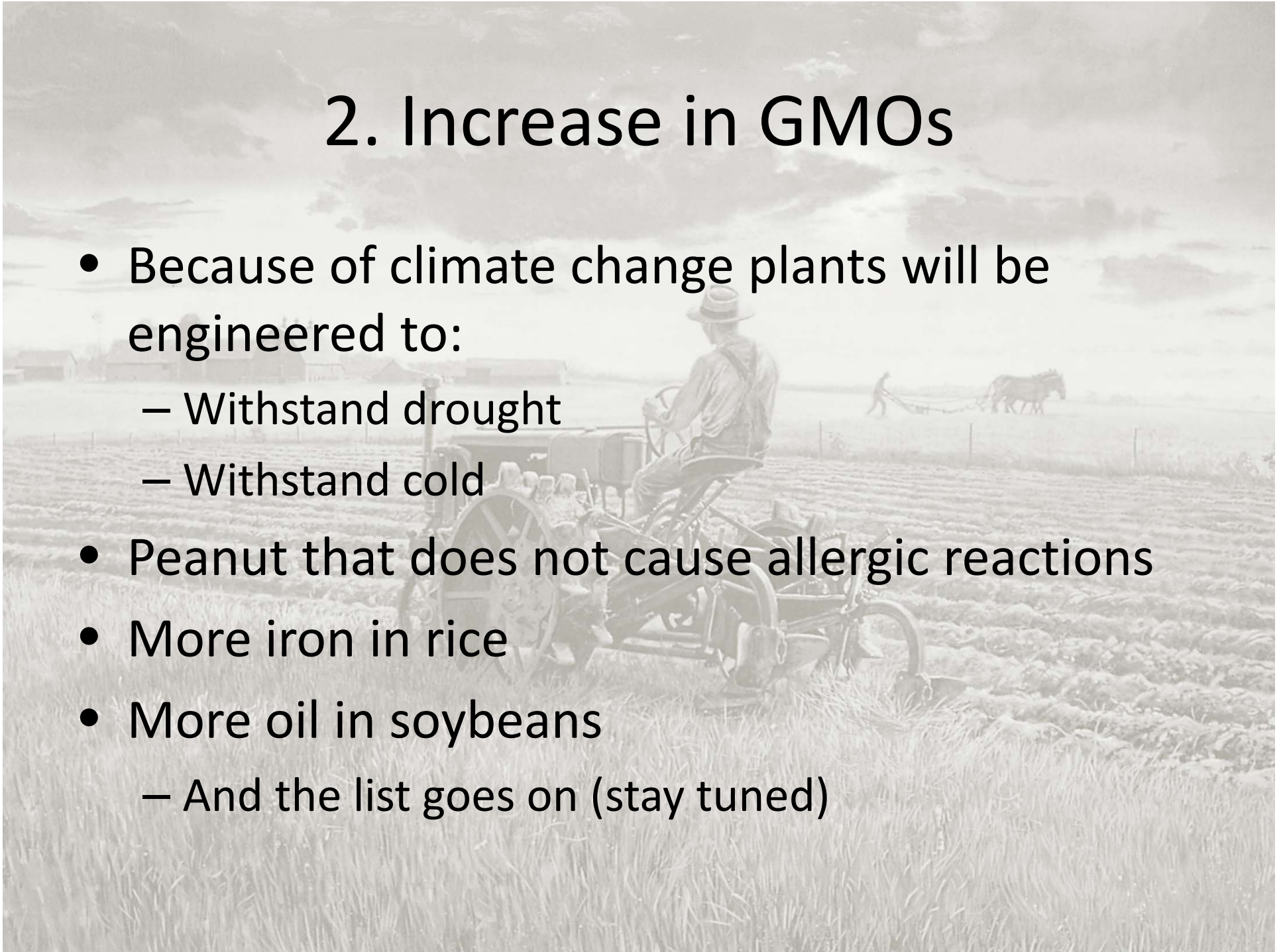


Precision farming technologies
could revolutionize agriculture

National Research Council

2. Increase in GMOs

- Because of climate change plants will be engineered to:
 - Withstand drought
 - Withstand cold
- Peanut that does not cause allergic reactions
- More iron in rice
- More oil in soybeans
 - And the list goes on (stay tuned)



Leading Anti-GMO Activist Reverses Position

JAN 23, 2013 07:58 PM ET // BY BENJAMIN RADFORD



One of the staunchest critics of genetically modified organisms (GMOs), environmentalist Mark Lynas, recently said he had been mistaken and that the threat of GMOs had been exaggerated by him and others for years.

According to an article on Slate.com, "If you fear genetically modified food, you may have Mark Lynas to thank. By his own reckoning, British environmentalist helped spur the anti-GMO movement

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DNEWSvideo



**DNews: Why Do
Headaches?**

"I discovered that one by one my cherished beliefs about GM turned out to be little more than green urban myths. I'd assumed that it would increase the use of chemicals. It turned out that pest-resistant cotton and maize needed less insecticide. I'd assumed that GM benefited only the big companies. It turned out that billions of dollars of benefits were accruing to farmers needing fewer inputs.... I'd assumed that no one wanted GM. Actually what happened was that Bt cotton was pirated into India and roundup ready soya into Brazil because farmers were so eager to use them. I'd assumed that GM was dangerous. It turned out that it was safer and more precise than conventional breeding using mutagenesis for example; GM just moves a couple of genes, whereas conventional breeding mucks about with the entire genome in a trial and error way. But what about mixing genes between unrelated species? The fish and the tomato? Turns out viruses do that all the time, as do plants and insects and even us—it's called gene flow."



LEADERSHIP

1/17/2013 @ 7:07AM | 5,891 views

From Forbes

'I Was Wrong:' How One Activist's Apology Changes the GMO Debate

[+ Comment Now](#) [+ Follow Comments](#)

It wasn't just an acknowledgement of error. It was the recantation of an agenda.

On January 3, British activist [Mark Lynas apologized](#) to a gathering of academics at Oxford for his staunch opposition to the production and distribution of genetically modified organisms ([GMOs](#)). Lynas cogently detailed a number of reasons why he was both wrong and wrongheaded in the role he played spearheading the anti-GMO movement in Europe. Wrong, because of specific factual errors and oversights. Wrongheaded, for choosing passionate advocacy over disinterested science.



Are GMOs **SAFE?** **YES.** The National Academies of Sciences, Engineering, and Medicine 2016 report reaffirms

Over
900 studies and publications were examined



20+ scientists, researchers and agricultural and industry experts
over a 2 year period
reviewed animal studies, allergenicity testing, North American and European health data, and more



years of data since GMO crops were introduced

SAFE.



No substantiated evidence of a difference in risks to human health between current commercially available genetically engineered [GMO] crops and conventionally bred crops.

The National Academies of
SCIENCES • ENGINEERING • MEDICINE

Full report available at <http://nas-sites.org/ge-crops/>

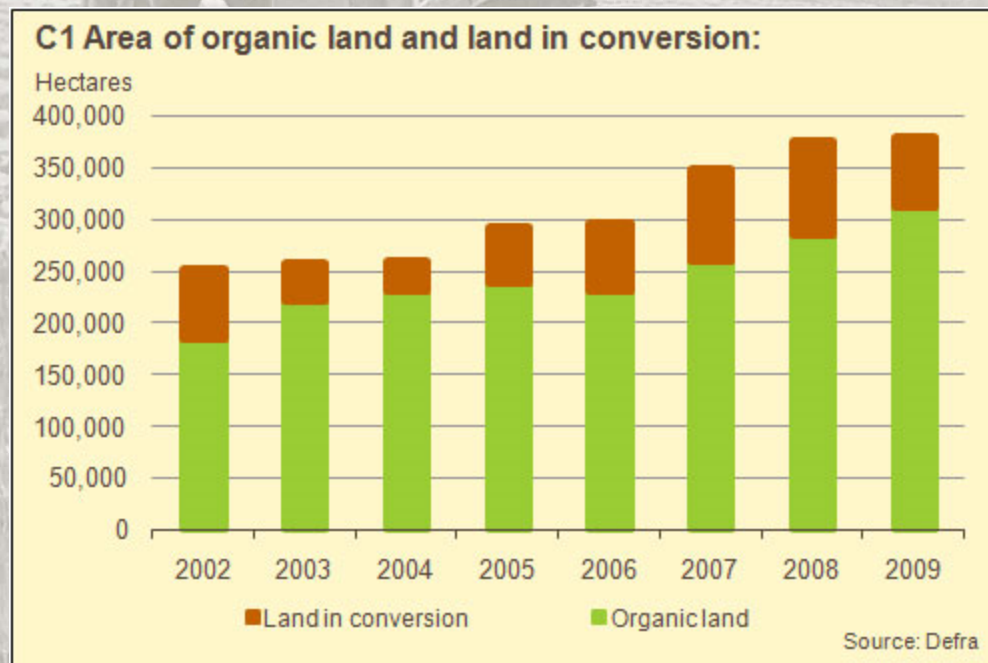


Nutrigenomics

- Your personal genetic code will be computer generated in a matter of hours.
- Specialized diets will be formulated to combat the diseases your are genetically programmed to experience.
 - The diets will probably be GMO based

3. Organic Farming

- Organic cropland has grown 20% over the past 10 years
 - It will continue to grow



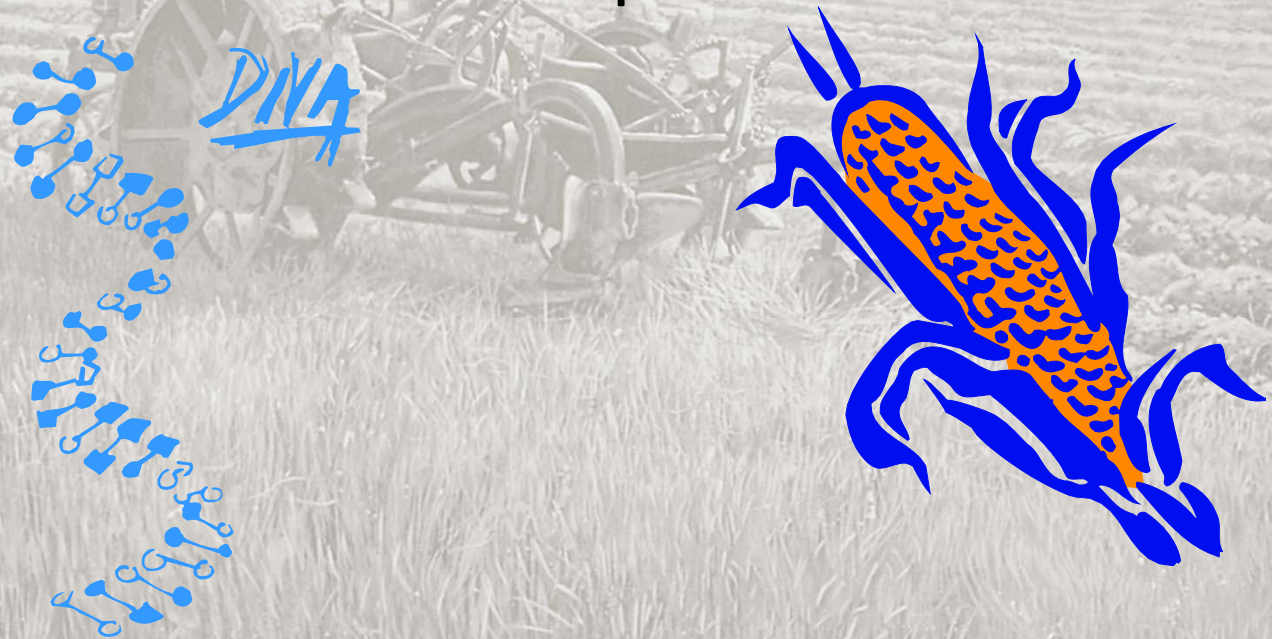
4. Miniaturization

- Miniature TV cameras will be everywhere
- Crime is down substantially in Monaco today because miniature cameras have been installed in public areas
- Everything on a farm can be monitored with miniature cameras



5. Pharmaceuticals

- Farmers will grow crops that cure cancer
- With gene stacking technology it may be possible to insert specific genes that fight cancer into corn or another plant



5. Pharmaceuticals

- With gene stacking technology the phytic acid gene has been removed from soybeans so it may be possible to insert cancer fighting compounds into a crop.
 - Note: phytic acid (or phytate) can not be digested by livestock. It is basically phosphorous.; so most of the phosphorus in corn and soybean meal passes through the digestive tract unused and is excreted in the manure. Naturally, this excreted phosphorus can potentially contribute to environmental pollution if high-phosphorus manure is applied to cropland and the excess phosphorus eventually finds its way into surface waters.

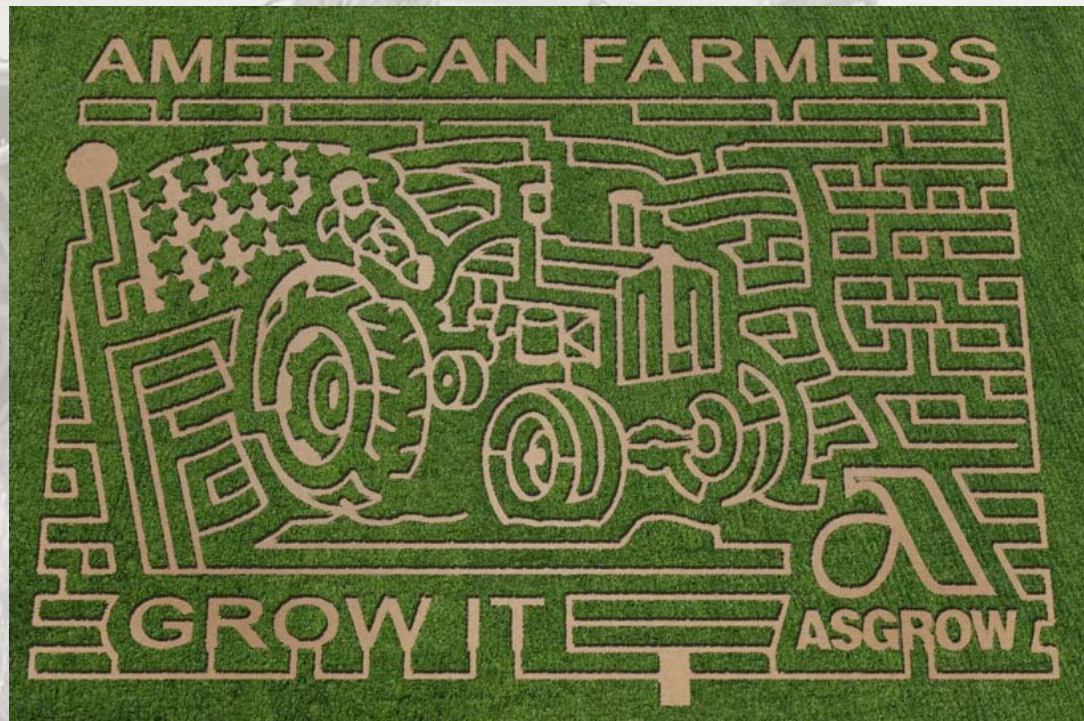
6. Robotics and Drones will be used in Farming

- Robotics
 - Tractors
 - Milking cows
 - Shearing sheep
- Agricultural Drones
 - Scouting Crops
 - Applying Ag Chemicals
 - Checking livestock, fences



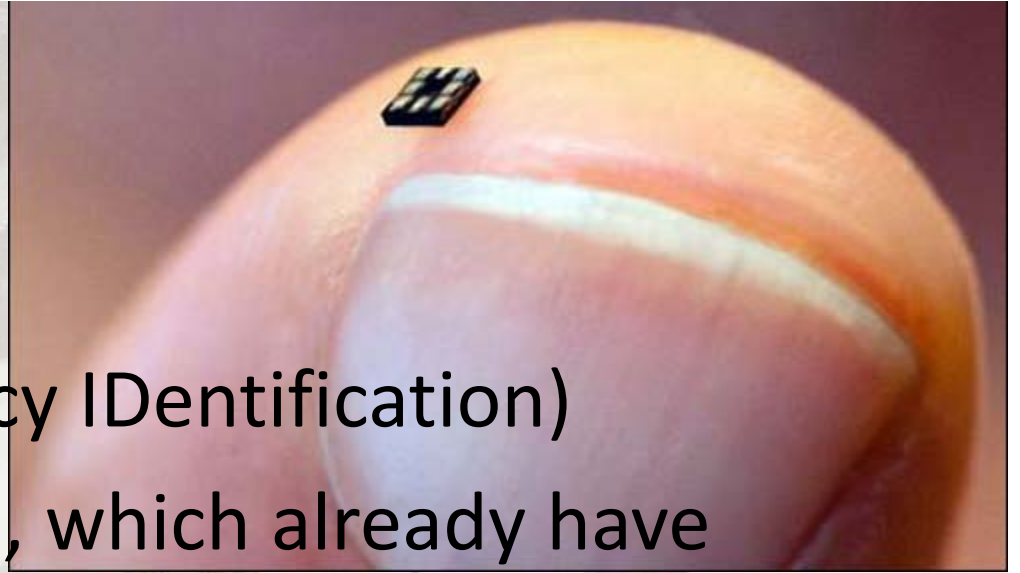
7. Agritourism

- To survive farmers will need to turn to agritourism and farm entertainment
 - Corn Maze
 - Hay rides
 - Hunting
 - Fishing



8. RFID

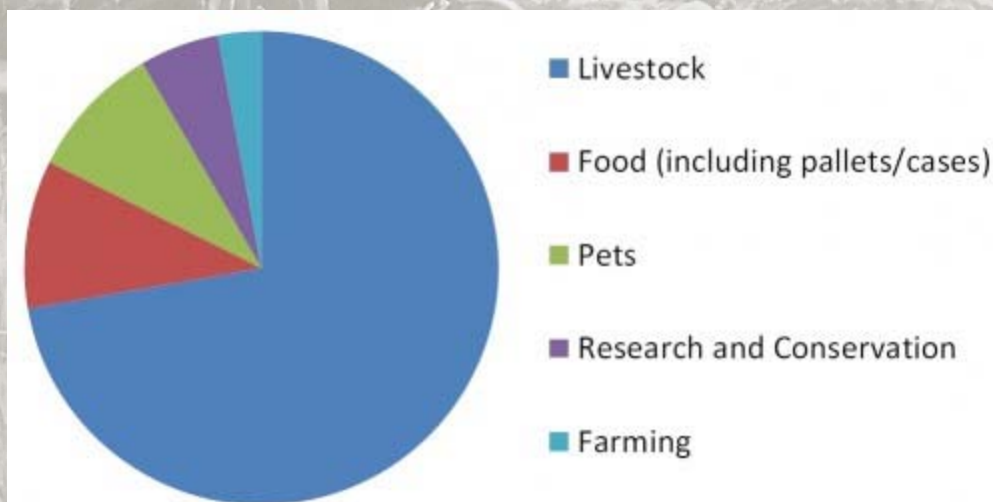
- RFID (Radio Frequency IDentification)
- Miniscule microchips, which already have shrunk to half the size of a grain of sand.
- They listen for a radio query and respond by transmitting their unique ID code. Most RFID tags have no batteries: They use the power from the initial radio signal to transmit their response.





RFID

- Cattle will be traced from birth to market with RFID.
- Consumers can pick up a package of ground beef, scan it, and see a picture of the animal it came from, the farmer who raised it, and the entire life story of the animal.



9. Water Wars

- Water will be a major issue in agriculture during the next 100 years



10. Women Will Rule the World

- Women are starting businesses 9 times faster than men
- The majority of new businesses are small - this is where the growth is



College Enrollment

