

History of the Bovine TB Eradication Program in the US The Original One Health Program, Science, Regulations, Politics

Presented at Manhattan, Kansas

March 20th, 2018

by

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Origins of *Tuberculosis* in North America

Fossil evidence suggests, possible ancestors of the *Mycobacterium* were present in the New World during the late Pleistocene era (~17,000 yrs ago) in bison, bighorn sheep and Mastodons.



DNA fragment PCR, followed by Spoligotyping studies, and lipid analysis consistent with known isolates of M TB complex



Origins of TB in New World – Arrived with Migrating Hosts

Low level introduction of TB likely occurred with early human migration waves, 20K years ago and 11.5K years ago.

Archeological evidence also supports hypothesis that pinnipeds may also have brought a strain of TB complex to the New World from Mycobacteria's origin in Africa



Mycobacteria isolates found in frozen ancient Incan mummies remains points to common origins of Mycobacterium ancestors. Nature-Oct 2014

Origins-*Mycobacterium bovis* in North America

Current evidence indicates that the ancestors of modern *Mycobacterium bovis* isolates arrived in the New World with the European explorers and colonists; within their livestock, and themselves.



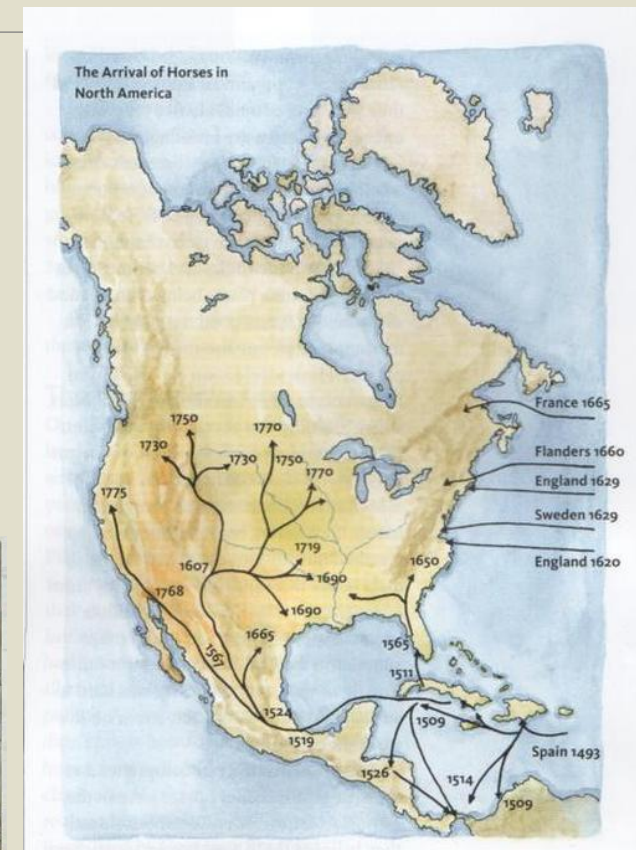
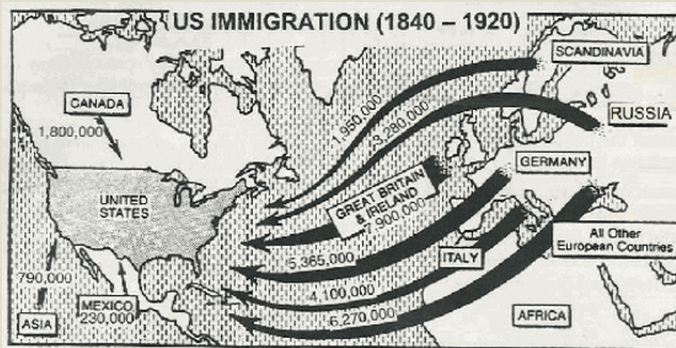
White Star Line!

LIVE-STOCK & CARGO STEAMERS.
Liverpool and New York.
REGULAR WEEKLY SAILINGS.

| | |
|---------------------------|-------------|
| BOVIC (twin screw)..... | 4,200 tons. |
| NAEVIC (twin screw)..... | 4,204 tons. |
| CUFIC..... | 4,500 tons. |
| NOMADIC (twin screw)..... | 5,700 tons. |
| TAURIC (twin screw)..... | 5,700 tons. |
| BUSIC..... | 4,500 tons. |

SPECIFIED Atlantic Lane routes throughout the year. Large and powerful steamers, specially constructed for the safe, comfortable, and speedy conveyance of live stock, including horses, ponies, sheep, etc. Efficient fan and hatch ventilation. Electric light and water supply on each deck. All stock landed at the company's New York pier. Free transfer car-load lots to railroads in stock cars. Lowest current rates.

For further particulars apply to ISMAY, IMBRIE & CO., 39 Water Street, Liverpool, or to H. MAITLAND KERSEY, Agent, 29 Broadway, New York.



Rudolf Virchow 1821–1902

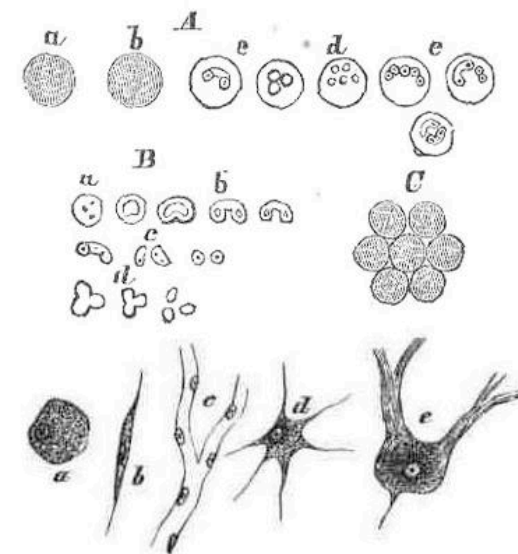
At the time very well respected German physician, pathologist, and anthropologist.

“Medicine is a social science, and politics is nothing more than medicine on a grand scale.”

He believed that ***‘all epidemics were social in origin’***

He became an outspoken well educated critic of the radical new “germ theory of disease” being proposed by many other colleagues of his time.

R Virchow's cellular pathology



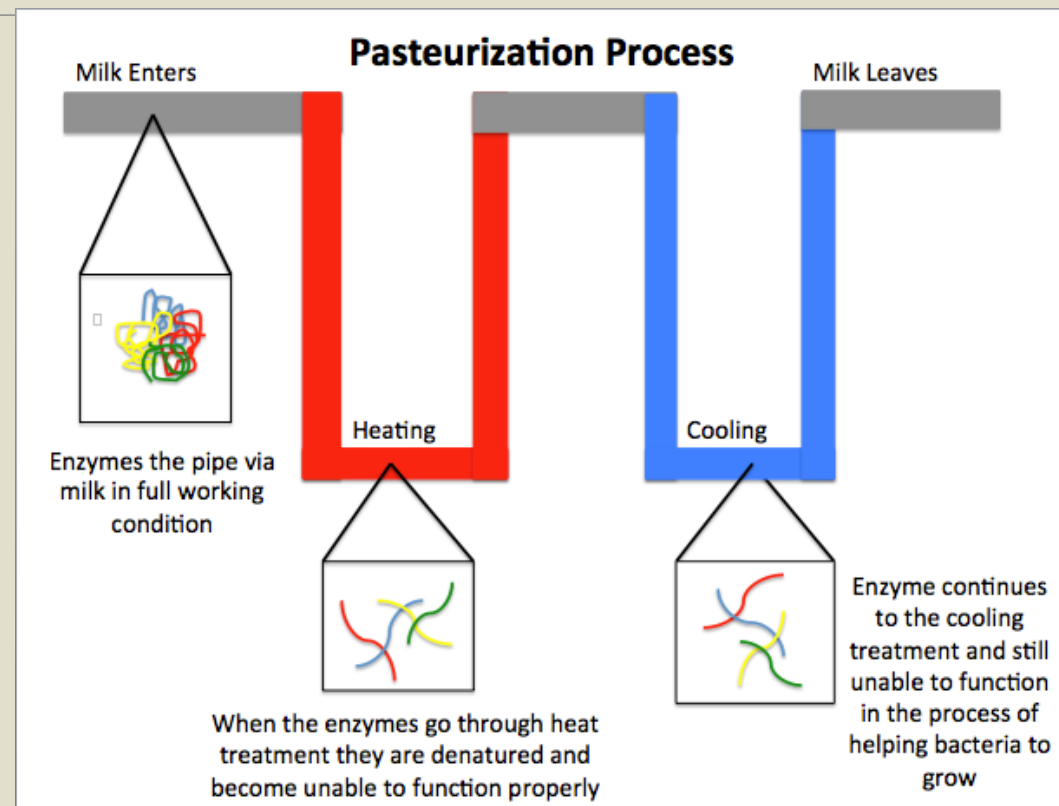
Pasteurization - wine and beer industries



Pasteur's many discoveries helped disprove "spontaneous generation", and laid the foundation for germ theory of disease... and eventual adoption by dairy industry

1864-Louis Pasteur-Pasteurization Process

Microbiologist and Chemist



Heat beer and wine to prevent bacterial contamination, spoilage, and bad tastes

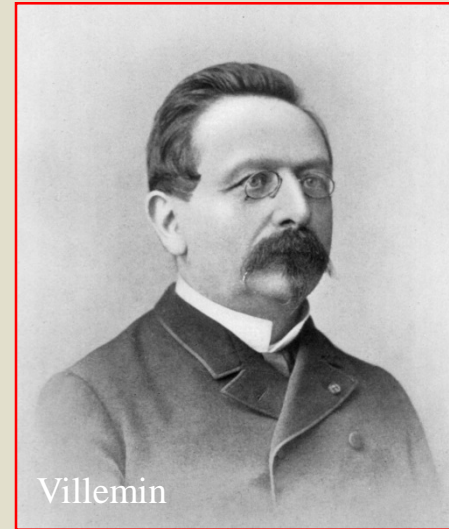
Global TB Community, Tuberculosis- J.A. Villemin-France

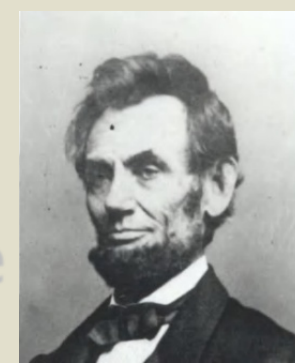
In late 19th and early 20th Century Europe and North America, TB killed one out of every seven people!

1865: Jean-Antoine Villemin- (French) transfer of infectious material from humans or cattle tubercles to rabbits. Interspecies transmission demonstrated.

Villemis's Conclusions:

- 'Tuberculosis was not a spontaneous disease,' or genetic, rather
- TB was an infectious disease , the effect of "some contagious agent."





President Lincoln in 1862 establishing the USDA, and 1st Land Grant College at Manhattan Kansas State by signing the Morrill Act.

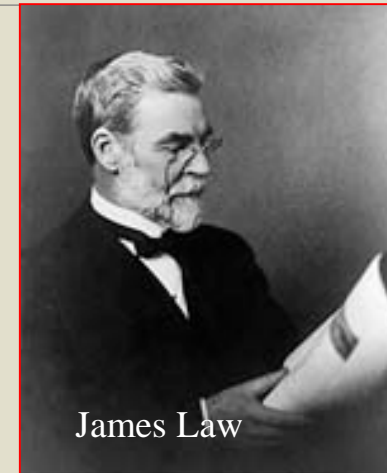
- Farm & Foreign Agriculture Service
 - Farm Service Agency
 - Foreign Ag Service (FAS)
 - Risk Mgt. Agency
- Food Safety
 - Food Safety Inspection Service (FSIS)
- Food, Nutrition, & Consumer Services
 - Food & Nutrition Service
 - Center for Nutrition Policy & Promotion
- Natural Resources & Environment
- Forest Service
- Rural Development
 - Rural Business-Cooperative Service
 - Office of Community Development
 - Rural Housing Service
- Research, Education, & Economics
 - Agricultural Research Service (ARS)
 - Economic Research Service
 - National Ag Statistics Service (NASS)
 - Cooperative State Research, Education, & Extension Service
- Marketing & Regulatory Programs
 - Ag Marketing Service
 - Grain Inspection, Packers, & Stockyards Administration
 - **Animal & Plant Health Inspection Service (APHIS)**

Tuberculosis & One Health late in the late 19th Century

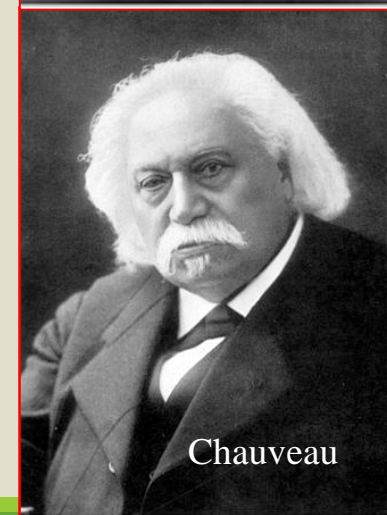
1877, James Law, (Cornell Veterinary School, 1st US Dean),

and later in

1885, Jean-Baptiste “Auguste” Chauveau (French Professor and Veterinarian) BOTH proposed that bTB is a communicable disease & transmissible from under-cooked meat or milk to humans



James Law



Chauveau

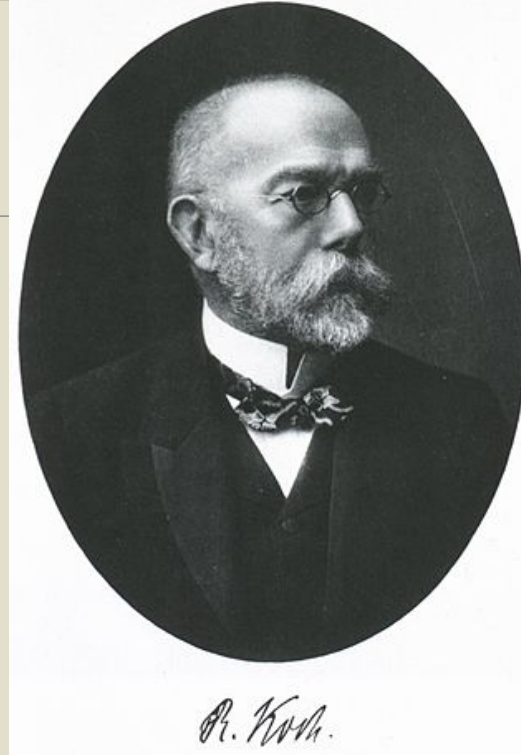
Robert Koch-German Physician

On March 24, **1882**, Dr. Robert Koch announced the discovery of *Mycobacterium tuberculosis*

1905 Received the Nobel Prize for “his investigations and discoveries in relation to tuberculosis”.

That work lead to his famous 4 postulates ^{*(1-4)} regarding the “Germ Theory of Disease” and helped disprove “spontaneous generation”.

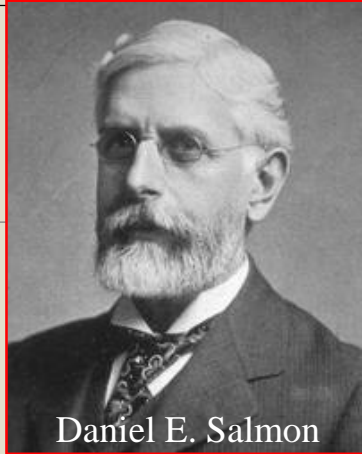
*(1) Organism isolated in every case, 2) grown in pure culture, 3) cultured orgs cause disease in new host, 4) re-isolated...





United States Department of Agriculture

US Bureau of Animal Industry (BAI)



1883- Veterinary Division created within US Department of Agriculture

1884- BAI created by congressional mandate; Daniel E. Salmon- 1st Director

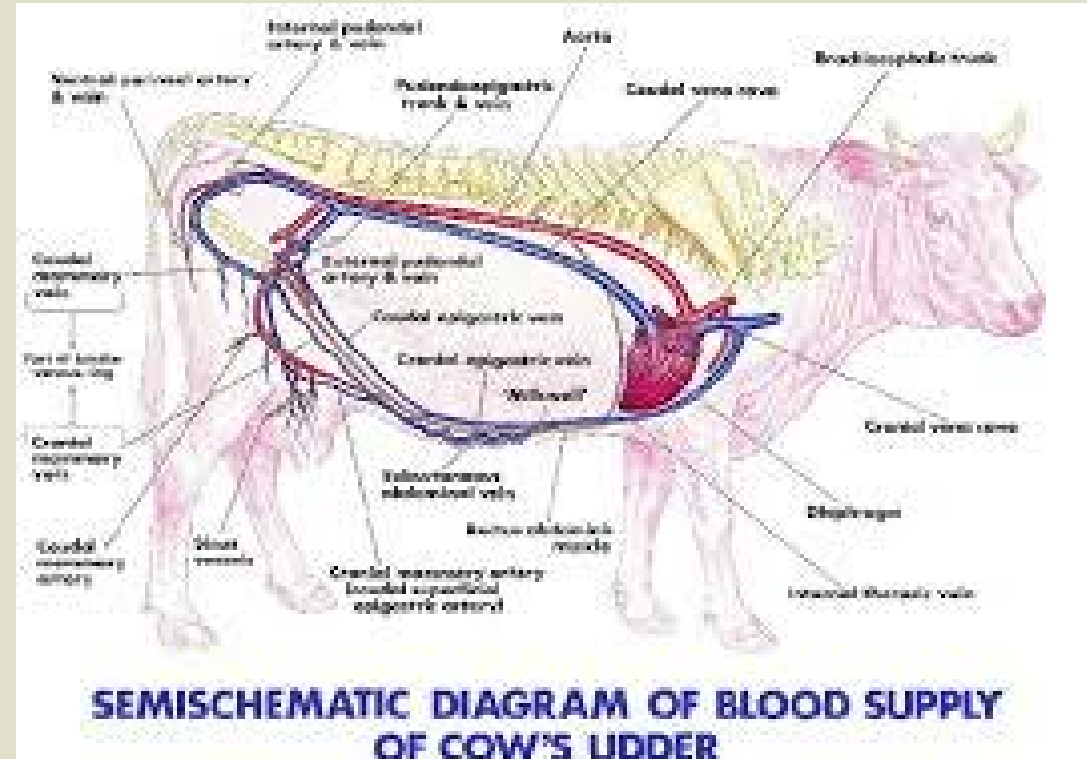
“...prevent the exportation of diseased cattle, and to provide means for the suppression and extirpation of bovine pleuropneumonia (BPP) and other contagious diseases.”

Due to experience and success from **BPP Eradication Program**, the BAI gained the authority to “condemn animals” capable of spreading disease, and stop movement across state lines, ... interstate.



Tuberculosis & One Health late in the late 19th Century

1889, Harold Ernst (MD) and Austin Peters (DVM) demonstrated through a series of experiments that TB-affected cows may produce milk containing the *Mycobacterium* bacillus, irrespective of the presence or absence of lesions in the udder...



Koch's Tuberculin - key to the TB Campaigns

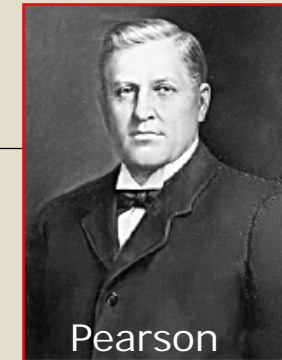
1890- Koch develops tuberculin, ... failed as a treatment.

1891- Veterinarians; Gutmann, Bang, and McFadyean begin experimental use of “Koch’s lymph” to diagnose bovine tuberculosis. Physical exam’s of cattle at the time diagnosed only ~ 1 in 10 of all tuberculous cows.

1892- Dr Leonard Pearson , DVM (age 24) travels to Dr Koch’s lab and brings tuberculin to Pennsylvania for first public cattle tests in the US.



- ❑ Preventative vaccine?
- ❑ A Treatment?
- ❑ “Koch’s lymph, aka
- ❑ Paratoloid
- ❑ Tuberculin”



Pearson

March 3rd 1892 - First cattle herd TB tested in the USA!

Dr. Pearson, DVM returned from Europe, and convinced a Trustee of University of PA and owner of a Jersey cattle herd, **Mr Joseph Gillingham, Clairmont Farms of Villanova, PA** to be the first US herd tested.

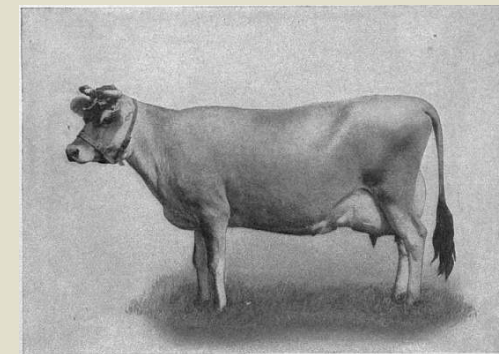
- Event was advertised and attended by cattle producers, veterinarians, physicians, ... covered by newspaper reporters
- Dr. W.L. Zuill (MD) – local critic and professor of veterinary surgery at Penn, headed a commission to discredit the diagnostic properties of tuberculin.
- Dr. Samuel Dixon- Academy of Natural Science in Philadelphia, PA- called ‘Gillingham a fool, and Dr Pearson a dreamer’

Pearson’s TB Test Procedure:-subcutaneous Tuberculin injection, and close monitoring of body temperature

51 of 79 showed positive temperature spike reactions;65% Reactors...

Necropsies began on farm- continued at University of Pennsylvania

All 51 had gross lesions, 65% prevalence!



1895 Pennsylvania became the first state to enact a TB testing and control program

Dr Pearson on Mr Joseph Gillingham“..his sacrifice would come to be a blessing to every cattleman in the US.”

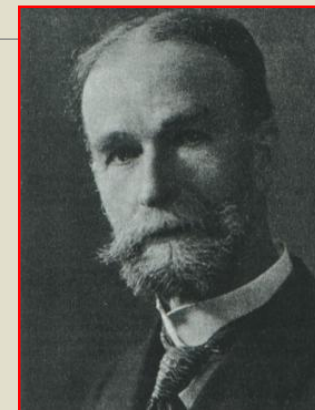
Late 19th Century-TB and One Health Progress

1893- First Official Tuberculin Intradermal skin test near New Charlotte, NY by Dr. E.C. Schroeder (15/34 reactions, 13/15 lesions)... **44% within herd bTB prevalence**

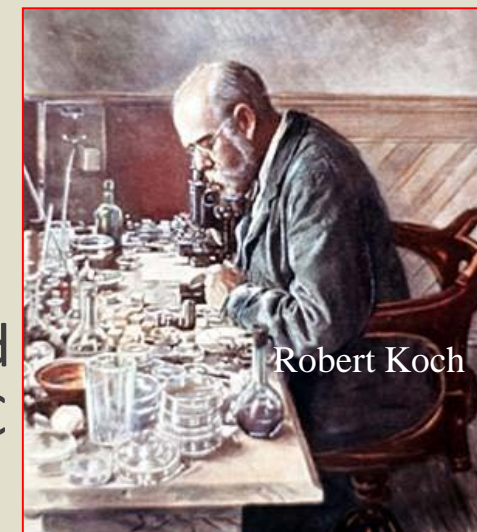
1895: Dr Theobald Smith, MD USDA, B.A.I. Vet Division traveled to Europe to consult with famous Dr Robert Koch... veterinarians Dr's Austin Peters, DVM and Langdon Frothingham, DVM and he had '***observed apparent differences in virulence between human and bovine tubercle bacilli when inoculated into rabbit models***'.

1901: Dr Koch reported these finding at London-International Tuberculosis Congress, but forgot to credit Smith or US-BAI Smith and co-workers received credit in 1908 when International TB Congress was hosted in Washington, DC

1900- Tuberculin testing required on all Imported cattle.



Smith



Robert Koch

Bovine TB Eradication Program: Pennsylvania lead the Way

1895 Pennsylvania first state to establish program-Voluntary

- ~2 million cattle, estimated prevalence 2-3%
- Some herds with 30% to 100% infected.
- Penn State Livestock Sanitary Board formed
- \$40,000/yr- TB, anthrax, glanders, rabies
- Option of Test/Remove with Indemnity, or Bang's Method
- PA manufactured tuberculin and anthrax vaccine

1898- Mandatory testing

- 1899- 33,000 cattle tested
- 13.7% positive
- \$102,909 indemnity payments (\$22.56/head)



USDA Bureau of Dairy Industry Records.
Special Collections, National Agricultural Library

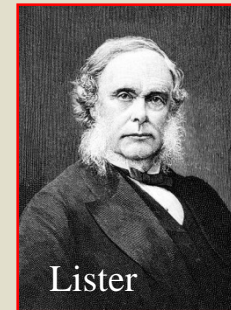
Popular opinions and Political ramifications

1901, Robert Koch stated: “I should estimate the extent of infection by the milk and flesh of tubercular cattle, and the butter made of their milk, as hardly greater than that of hereditary transmission, and I, therefore, do not deem it advisable to take any measures against it.”

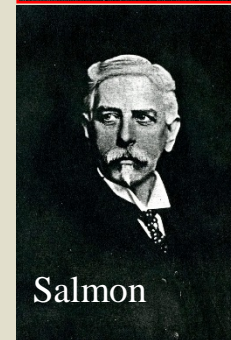
Koch was countered by McFadyean, Bang, Ravenel, Salmon, Lister, Virchow, Smith, and Nocard.

Koch’s declarations emboldened special interest groups and political opposition to eradication.

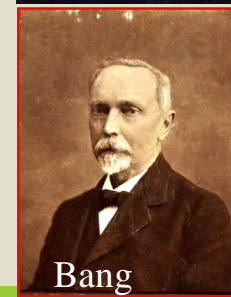
Koch’s influence carried the discussion well into the 1930s, long after the rest of the science community had settled on the issues.



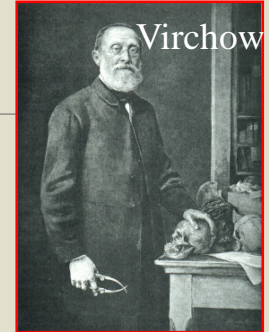
Lister



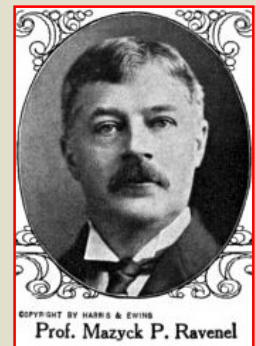
Salmon



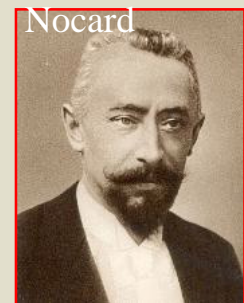
Bang



Virchow



Prof. Mazyck P. Ravenel



Nocard

Veterinarian Edmond Nocard Pasteur Institute, Paris

1902-“all mammalia, including monkeys, become tuberculous after ingestion of milk from tuberculous cows. It would be absurd to contend that man alone offers an exception to the rule”



BCG was derived from Dr Edmonds Nocard's strain of *M. bovis*

Veterinarians & Cities Lead TB Regs in early 20th Century

1896 - Under the direction of Dr Charles Cary, DVM of Montgomery, AL initiated the **first organized meat inspection program in the USA**. Cary would go on to **initiate meat in milk ordinances in all major cities of AL**.

1900-Dr Cary, became the 1st Dean of **Veterinary School at Auburn University**, reported that the rates of bovine TB were higher in herds house in **close-confinement** (dairy > beef); thus, Cary initiated an *open air clause* to the Alabama State cattle TB program

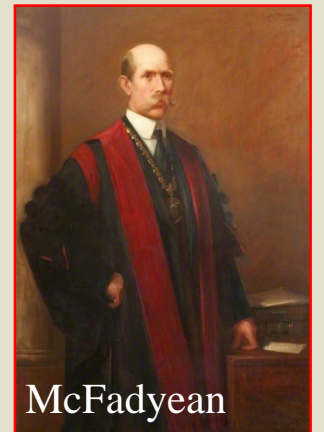


Bovine TB and zoonotic disease potential-UK

1900- Mazyck P. Ravenel reports that in 3 separate incidents, veterinarians were infected via accidental skin inoculation while performing postmortem exams on cattle.



1907- John McFadyean UK Royal Commission on Tuberculosis “A very considerable amount of disease and loss of life, especially among the young, must be attributed to the consumption of cows’ milk containing tubercle bacilli”





Interstate Movement of cattle, and tests lacks uniformity

1904: Interstate shipment testing for bTB begins, yet variability in timing, recording and reporting varies between the states.

Different approaches in different jurisdictions, without much consultation or cooperation between resulted in,

Huge variability in the application of tuberculin test(s)

1909: von Pirquet standardizes intradermal skin testing in humans

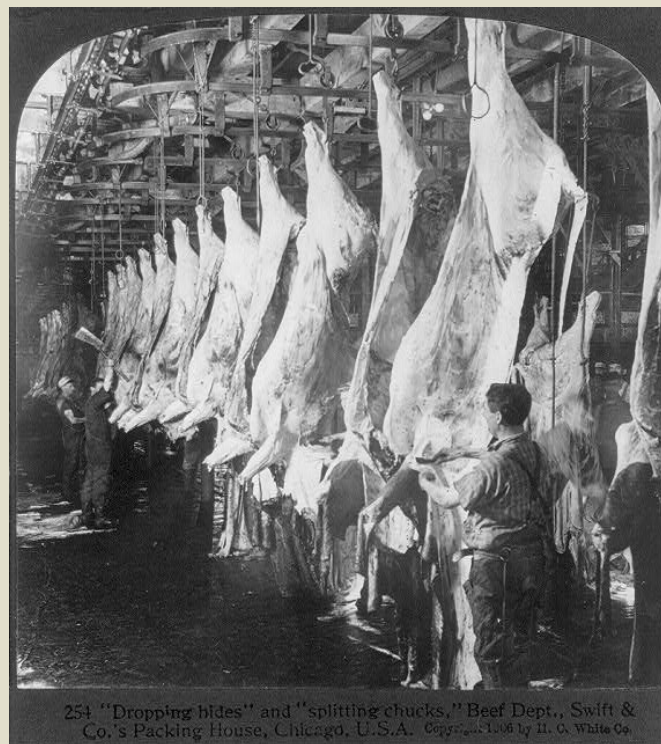
1909: S.H, Ward, MN State Vet: “It does not require any extended argument to convince us that the question to be discussed is the necessity for some uniformity...let regulations be drawn up by the Bureau of Animal Industry”

Tuberculosis - the original “One Health Program”

1900-
Mycobacteria bovis was estimated to be responsible for up to **25% of all human tuberculosis**, especially in children.



Tuberculous Cervical Lymphadenitis=“Scrofula”



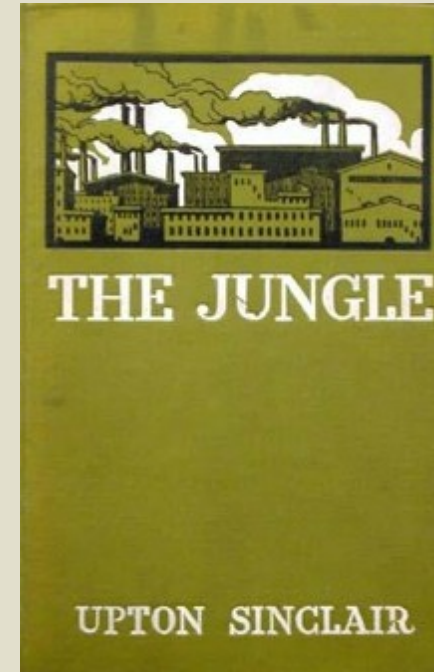
2/3 of all condemned US beef carcasses were for “tuberculous meat”.

Early 20th Century sets stage for TB Campaigns

1906 novel written by the American journalist Upton Sinclair. Unified demands by Science Medicine & Public Health Officials, as well public demand, for safe wholesome meat and milk from city markets.

1908-Chicago; 1st US City Pasteurization Milk Ordinances (placed on commercial milk).

1924-US Public Health Service Standardized Milk Ordinance (SMO).



Tuberculin Testing- Early challenges

1892-1915: Testing methods varied widely; Subcutaneous & Temp (Pearson), Ophthalmic test, Tine Test, Intradermal injection

- **Lack of standardized tuberculin**, ... plus Rumors, fears, misconceptions
- **Interval to retest** was unknown-desensitization varied from 7 to 60 days
- **Potential for fraud**; livestock owners could test their herd privately, and sell reactors to unsuspecting buyers, “plugging the test” – tuberculin injections to desensitize cattle
- **Massaging the test”**-manual massaging the injection site to disperse antigen, Antipyretics to prevent rise in temp after tuberculin injection
- **Issuing TB certificates w/o testing animals**
- **Elevated indemnity values and low cattle prices**, ...



Early 20th Century TB Testing; producers cost, education

In most of US TB testing of cattle was voluntary, at the farmer's expense, with no financial indemnity. Carcasses buried.

Pennsylvania's 'Pearson's plan'- Reactors are appraised, postmortems under official supervision, meat was salvaged, to offset loss to owners.

Public education- on-farm necropsies drew large crowds.

1907-D.F. Luckey, MO State Veterinarian & President of US Livestock Sanitary Assn) *"it is said that the highest end of education is to bring the general public to the point where it can appreciate the scientific work and know whose advice to follow"*



Bovine Tuberculosis circa 1905

“There is scarcely a subject related to agriculture or public health that has occasioned as much or as bitter discussion, or has led to the expression of so many divergent views as this one of tuberculosis in cattle.”

Leonard Pearson (1905) – Pennsylvania Plan, basic tenets of the US Eradication Program.

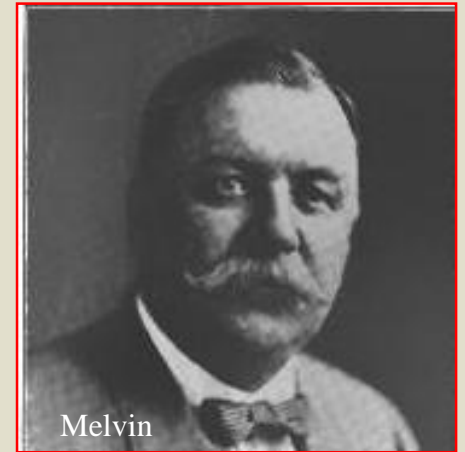


Leonard Pearson, DVM

US Bureau of Animal Industry

Tuberculosis 1906 Pathology Division

- Alonzo D. Melvin- Chief
- Proposed the Test and Removal method..
- Herds in MD, VA, DC tested annually for 12 years.
- **17,000 tests**, prevalence decreased from **19% to 0.17%**



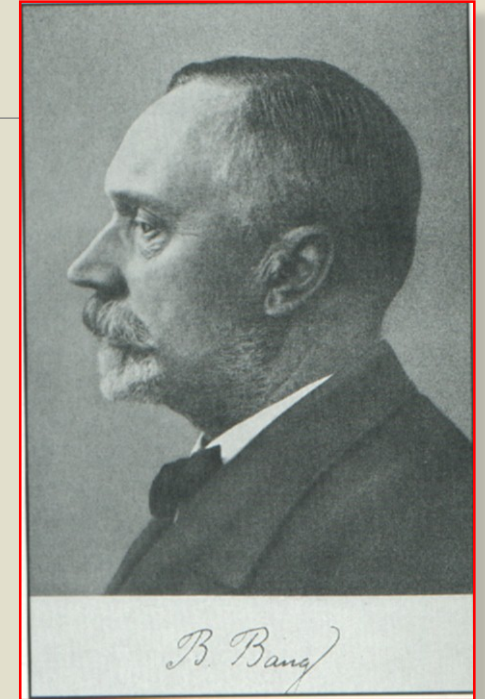
Methods of Control- Controversial

Dr. Bang's method- Control without slaughter

- Segregation in to 2 herds (reactors/non-reactors)
- Herds housed and controlled separately
- Calves removed at birth, colostrum/milk pasteurized
- Slaughter from infected herd done under inspection
- Closely monitor non-reactor herd
- Popular in Europe, not in US; costly, poor public acceptance

vs Test and Remove proposed by Dr Melvin

- Problems w/ indemnity, salvage use of milk/meat, quarantine
- Disposition of infected cattle - 1906 law- burning or burying diseased cattle
- In reality, infected portions trimmed or cattle sent to far away plants for slaughter



Tuberculous Cattle & Interstate Movement Issues

“James Dorsey of Gilberts, IL “Plugging the Test”

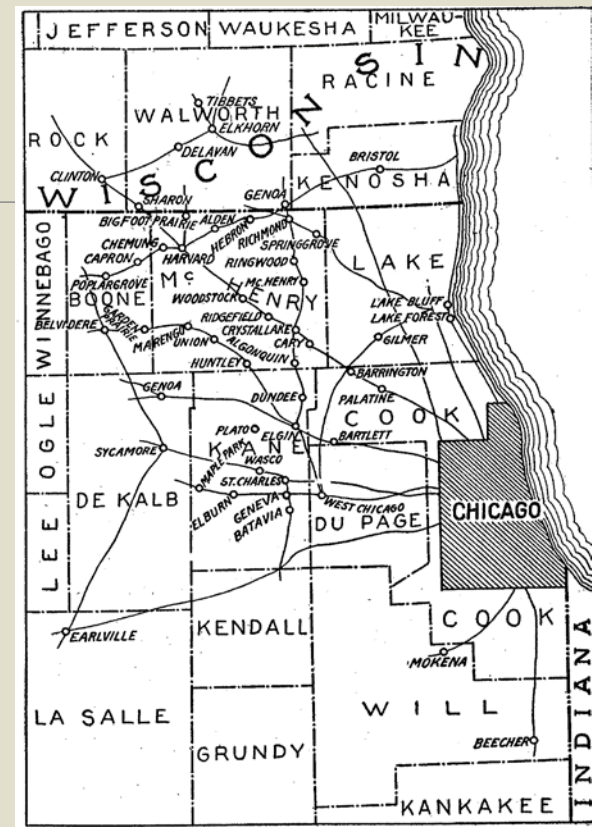
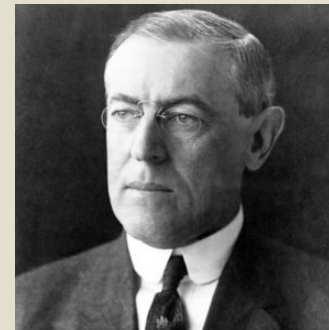
- At the height of the conspiracy, Dorsey was buying and selling ~20,000 cows/yr, ~50% tuberculous
- “Over 10-year period - **10,000 new foci of infections established across US, Canada and Mexico**

1914- 12 states ban cattle from IL, unless tested by federal veterinarians

1915- Dorsey indicted, sentenced to 8 yrs and Estimated responsible for thousands of human cases and compared to “Typhoid Mary” responsible for 47 cases...

1917- US enters World War I

1919- Woodrow Wilson, pardons Jim Dorsey after 4 years.





US bTB & National Vet Accreditation Program

- **1917** - \$75,000 allocated from congress to form the Tuberculosis Eradication Division.
 - BAI- Dr Melvin Director, Bovine TB Division headed by John A. Kiernan (TN)
- **1917**- 1st Uniform Methods and Rules approved.
 - 60 days after approval- 1st herd accredited; the US Soldiers Home cattle herd in Washington, DC.
- **1918- Accredited Veterinarian Program**-authorized private practitioners to perform TB tests (stemmed from similar programs; horse exports to Canada, TX Cattle Fever, ...
 - By end of 1920: >5500 accredited vets
- **1921**- Bovine TB Eradication offices in 46 states. Official test=Intradermal
- **1927**: >96,000 accredited TB cattle herds



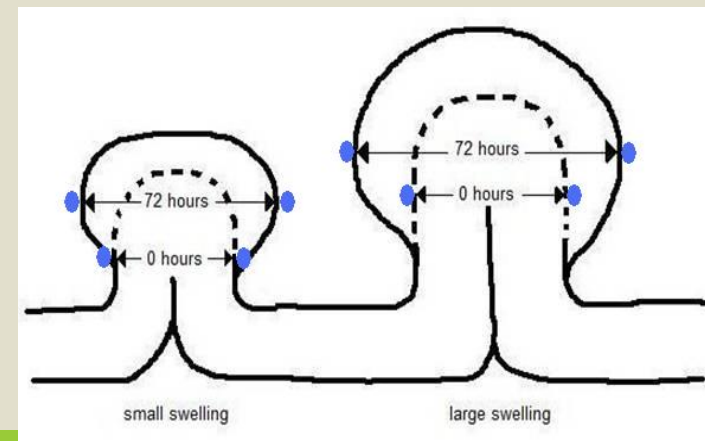
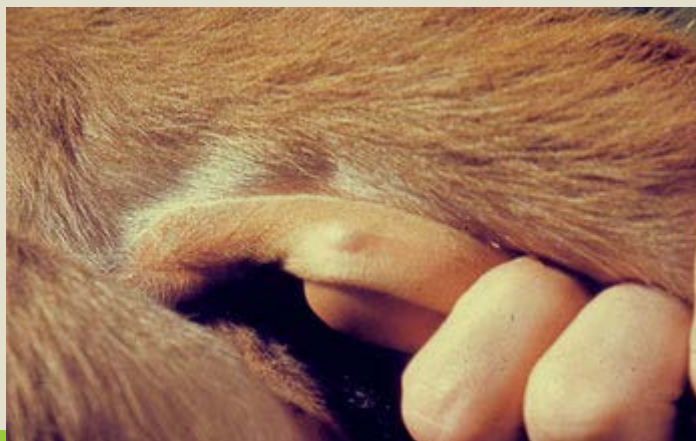
Methods of Control- Intradermal Testing for animal movement

A tuberculin skin test (also called a Mantoux tuberculin test) France circa 1908.

The TB antigens used in a tuberculin skin test are called purified protein derivatives, or PPD. 0.1mls of the PPD is injected intra-dermally.

The animals injection site is checked, for thickening, edema, and other inflammatory responses at 72 hours plus or minus 6 hours later.

Same vet that injects, reads!





Iowa Cow Wars

1925- Iowa Supreme Court hearing on whether the TB test was accurate and dependable

“Pitchfork Brigade”, Veterinarians doused with water, mud and eggs; vehicles damaged... “Iowa Cow War”



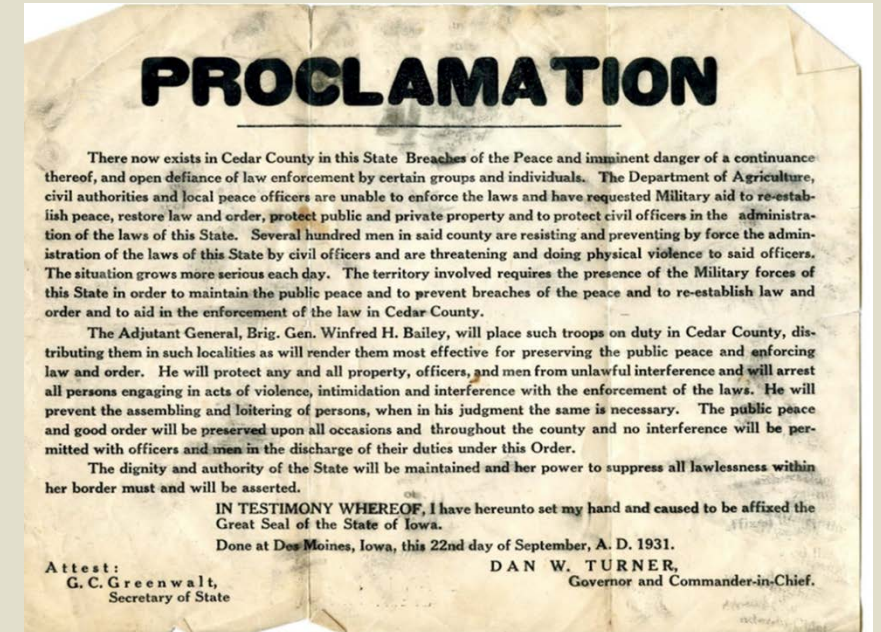
1931- Tipton, Iowa and Cedar County

State Vets were being threatened

Hundreds of farmers opposed to testing

Governor Daniel Turner imposed martial law and called in the National Guard

Martial law lasted 2 months



Science, Politics and the US bTB program

1901- >200,000 cattle tested before NVAP was established in 1918

- prevalence 3.9% to approaching 100% depending on herd and region of US.

1917- National bovine TB Program official cooperative program, 1st Uniform Methods & Rules and \$75K dollars to BAI, in same year

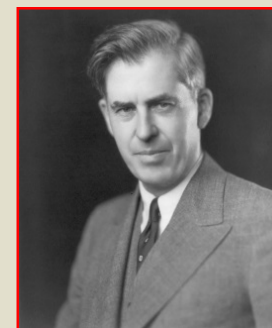
1917- Mr Henry A. Wallace a Wallace-Iowa Farmer & Newspaper editor, 'eradication of bovine TB is "an impossible undertaking" ...'

1921 – National Veterinary Accreditation Program Established

1933- Mr Henry Wallace becomes the US Sec of Ag, and in 1941 33rd US-VP

1941- USDA Secretary of Ag- Claude R. Wickard

- "the US is now practically free of bovine tuberculosis" National Prev; ~ 0.3%
- Every US county <0.5% prevalence, 232 Million Cattle Tested sine 1917.
- Cost of program over 23 years since 1917 ~ \$250 million US taxpayers.



• 1959 – Area Testing gives way to slaughter surveillance and movement testing



TB Programs and National Veterinary Accreditation Program bring Standardization of Test Documentation, Forms, and Permits

VS FORM 6-22 (FEB 99)

ALL INCOMPLETE RECORDS WILL BE RETURNED FOR COMPLETION
COOPERATIVE STATE - FEDERAL TUBERCULOSIS ERADICATION PROGRAM
TUBERCULOSIS TEST RECORD

FORM APPROVED OMB NO. 0579-0084
321513

STATE: _____ COUNTY: _____ TWP: _____ SEC: _____

HERD OWNER'S NAME - LAST: _____ FIRST: _____ MI: _____

PREVIOUS TEST DATE: _____ VET CODE: _____ TOTAL: _____ REA: _____ SUS: _____

HERD NUMBER: _____ HERD OWNER'S COMPLETE ADDRESS: _____

CERTIFICATION FOR PAYMENT
 State/Federal Expense Owner's Expense

DATE LISTED: _____

LESION: _____ TEST: _____ D-B: _____ U: _____

COUNTY: _____ TOWNSHIP OR DISTRICT: _____ SEC: _____ FARM NO.: _____

| REASON FOR TEST | | COMPLETE HERD TEST OF ALL ELIGIBLE ANIMALS | | SUMMARY | |
|-----------------|--------|--|----|----------|---------|
| AREA | RETEST | YES | NO | NEGATIVE | SUSPECT |
| 1 | 6 | NO. ELIGIBLE ANIMALS IN HERD | | | |
| 2 | 7 | KIND OF HERD | | | |
| 3 | 8 | METHOD OF TEST | | | |
| 4 | 9 | CAUDAL FOLD (CFT) | | | |
| 5 | 10 | CERVICAL (CT) (Sovine) | | | |

REACTOR TAG NO. _____

IDENTIFICATION NUMBER: _____ AGE: _____ BREED: _____ SEX: _____ RESULTS: _____ SIZE: _____ NRS: _____

DATE: _____ OWNER'S SIGNATURE: _____

THIS AUTHORIZATION TO TEST EXPIRES: _____

RT - Retag
NA - Natural Adolon
PA - Purchased Adolon

N - Negative
S - Suspect
R - Reactor

I hereby acknowledge receiving a copy of this record which I have examined and find correct.

Previous editions are obsolete.

According to the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number. The valid OMB control number for this information collection is 0579-0084. The time required to complete this information collection is estimated to average .3 hours per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information.

ALL INCOMPLETE RECORDS WILL BE RETURNED FOR COMPLETION
COOPERATIVE STATE - FEDERAL TUBERCULOSIS ERADICATION PROGRAM
TUBERCULOSIS TEST RECORD

FORM APPROVED OMB NO. 0579-0084
321513

STATE: _____ COUNTY: _____ TWP: _____ SEC: _____

HERD OWNER'S NAME - LAST: _____ FIRST: _____ MI: _____

PREVIOUS TEST DATE: _____ VET CODE: _____ TOTAL: _____ REA: _____ SUS: _____

HERD NUMBER: _____ HERD OWNER'S COMPLETE ADDRESS: _____

CERTIFICATION FOR PAYMENT
 State/Federal Expense Owner's Expense

DATE LISTED: _____

LESION: _____ TEST: _____ D-B: _____ U: _____

COUNTY: _____ TOWNSHIP OR DISTRICT: _____ SEC: _____ FARM NO.: _____

| REASON FOR TEST | | COMPLETE HERD TEST OF ALL ELIGIBLE ANIMALS | | SUMMARY | |
|-----------------|--------|--|----|----------|---------|
| AREA | RETEST | YES | NO | NEGATIVE | SUSPECT |
| 1 | 6 | NO. ELIGIBLE ANIMALS IN HERD | | | |
| 2 | 7 | KIND OF HERD | | | |
| 3 | 8 | METHOD OF TEST | | | |
| 4 | 9 | CAUDAL FOLD (CFT) | | | |
| 5 | 10 | CERVICAL (CT) (Sovine) | | | |

REACTOR TAG NO. _____

IDENTIFICATION NUMBER: _____ AGE: _____ BREED: _____ SEX: _____ RESULTS: _____ SIZE: _____ NRS: _____

DATE: _____ OWNER'S SIGNATURE: _____

THIS AUTHORIZATION TO TEST EXPIRES: _____

■ US Bovine TB Eradication Campaign Success 1917-1941

- **232** million tuberculin skin tests administered to cattle
- **3.8** million cattle slaughtered
- Economic benefits exceeded costs; estimate **10:1**
- Human *M. bovis* infection decreased dramatically



- **1945** that most **European countries** imposed mandatory test and slaughter programs as well as compulsory milk pasteurization



USDA-BAI- Summary early contributions

- **Differentiation of human and bovine tubercle bacilli.**
- **Differential virulence of the bovine and human bacilli in cattle.**
- **Morphological and biochemical differences in cultures of human and bovine tubercle bacilli.**
- **Transmission of bovine tubercle bacilli from cattle to swine.**
- **Worked on the immunization of cattle with BCG.**
- **Standardized Tuberculin potency testing.**
- **Alternative routes of tuberculin administration.**
- **Use of test and removal method of tuberculosis control.**



Bureau of Dairy Industry Records.
Special Collections, National Agricultural Library.

Pasteurization-slowly adopted to Milk

1864- Louis Pasteur

1912 Milton J Rosenau “The Milk Question” avoid scalding, bad taste= low temp, slow heating at **140 °F (60C) x 20 minutes**

1913- Jane H. Rider- AZ championed the link between infant mortality and contaminated raw milk.

1912 to 1937, without any pasteurized milk ordinance England and Wales, lost **65,000 people** who died of tuberculosis from TB contaminated milk consumption.

1947-States begin to enact Mandatory Milk Pasteurization

1973-FDA; Pasteurization required for interstate commerce

* Wilson, GS 1943, The Pasteurization of Milk



Methods of Control- Meat Inspection



1890's-Germany Robert Von Ostertag- "Father of Veterinary Meat Inspection"

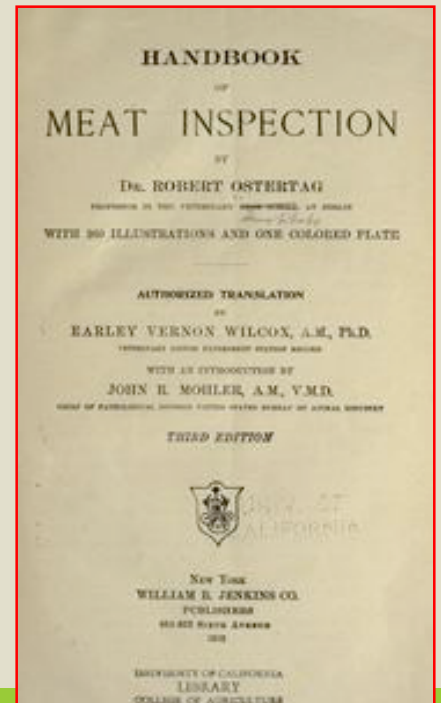
- Remove only animals with "open" lesions and track visibly infected animals.

Manchester Plan (England), called for periodic testing of milk for bacilli with trace back to herd of origin for testing of individual animals

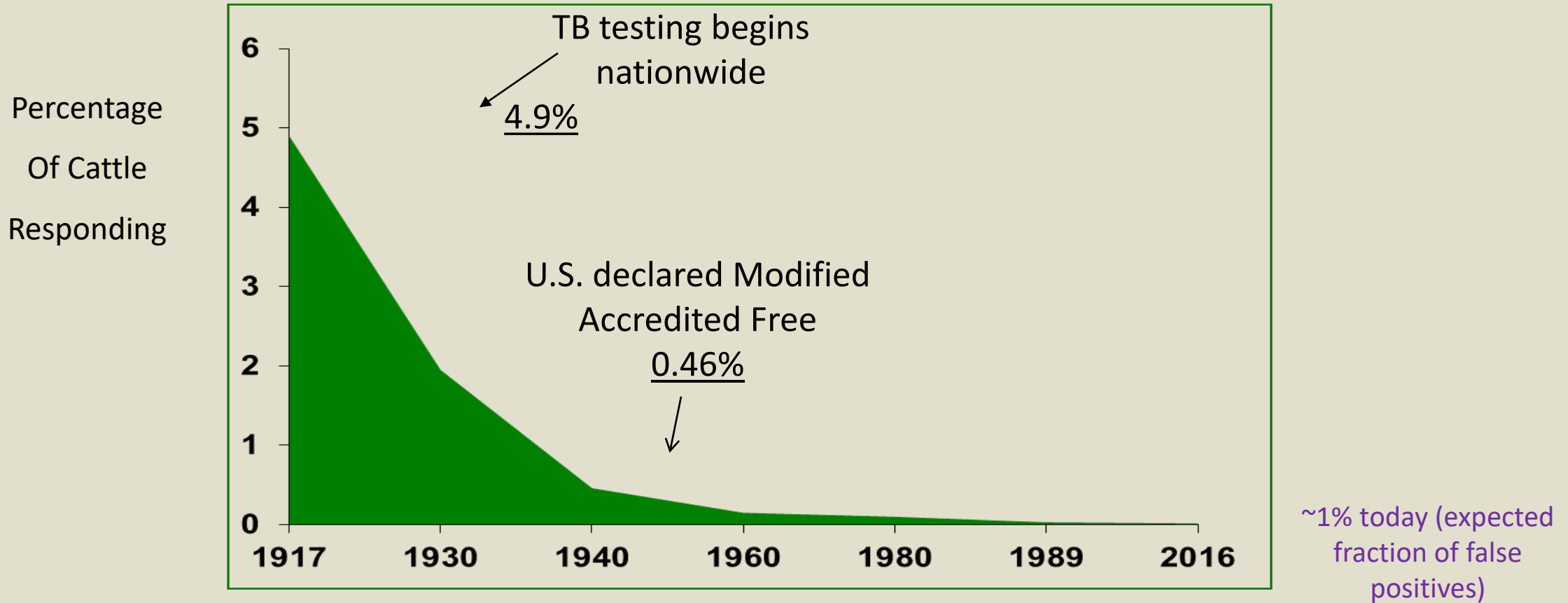
The French- relied on BCG vaccination as a control method

1906-The Pure Food and Drug Act and Federal Meat Inspection Act

1959-Detection, surveillance focus switches from area herd testing to slaughter surveillance w/ traceback



Percentage of U.S. Cattle Responding to the Skin Test, 1917 - 2016



August 2016-California regains bTB Free Status

August 2016



Bovine Tuberculosis California Update

California is Classified as “Accredited Free” for TB

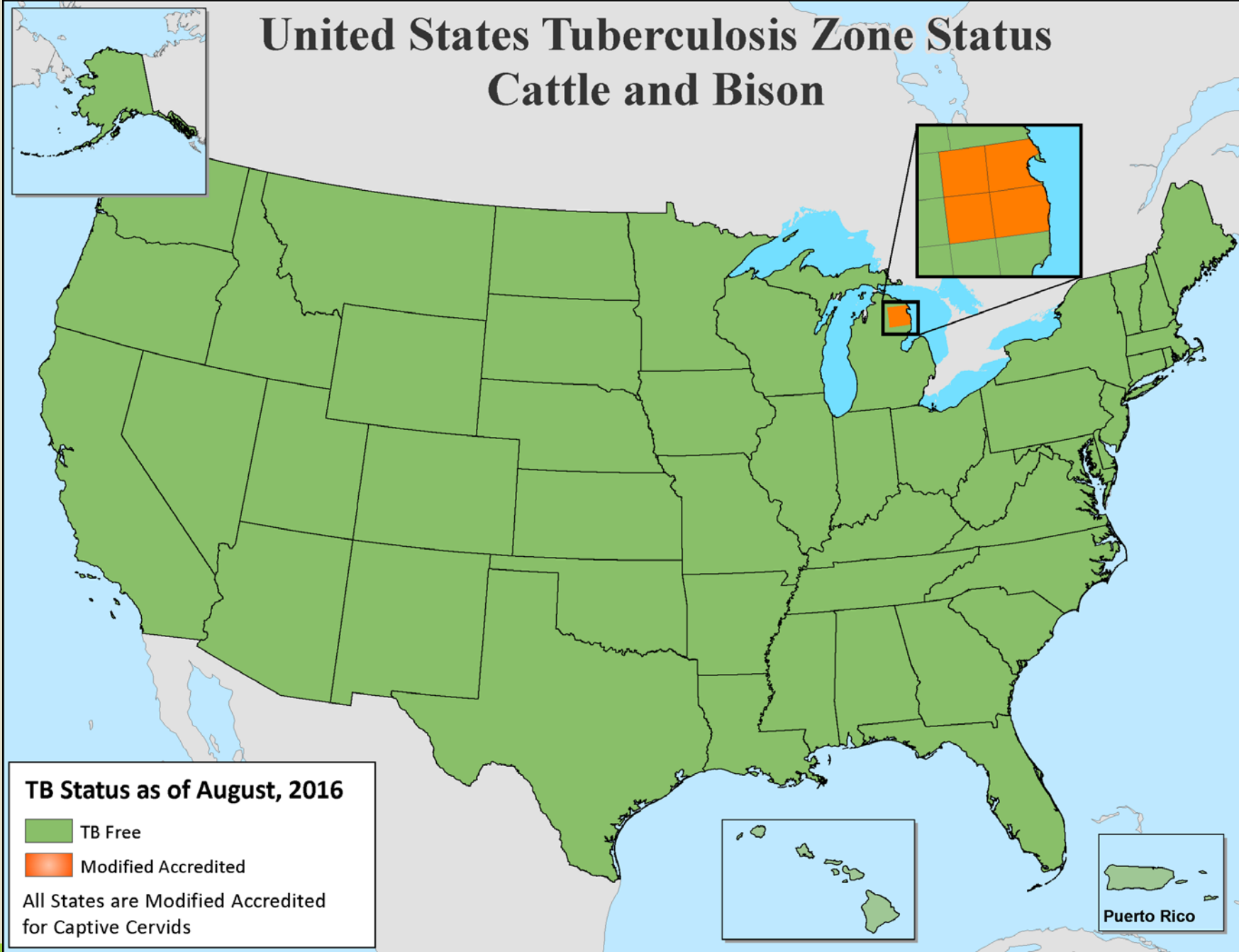
California first gained “TB-Free” status in 1999 only to lose it in April 2003 after bovine TB was confirmed in three dairy herds in the central valley. After depopulating the affected herds and tracing and testing the associated cattle, California regained “TB-Free” status in April 2005. Bovine TB was detected in a Fresno County dairy herd in December 2007. Two associated dairy herds were confirmed TB-affected in May 2008, for a total of three

California TB Investigations

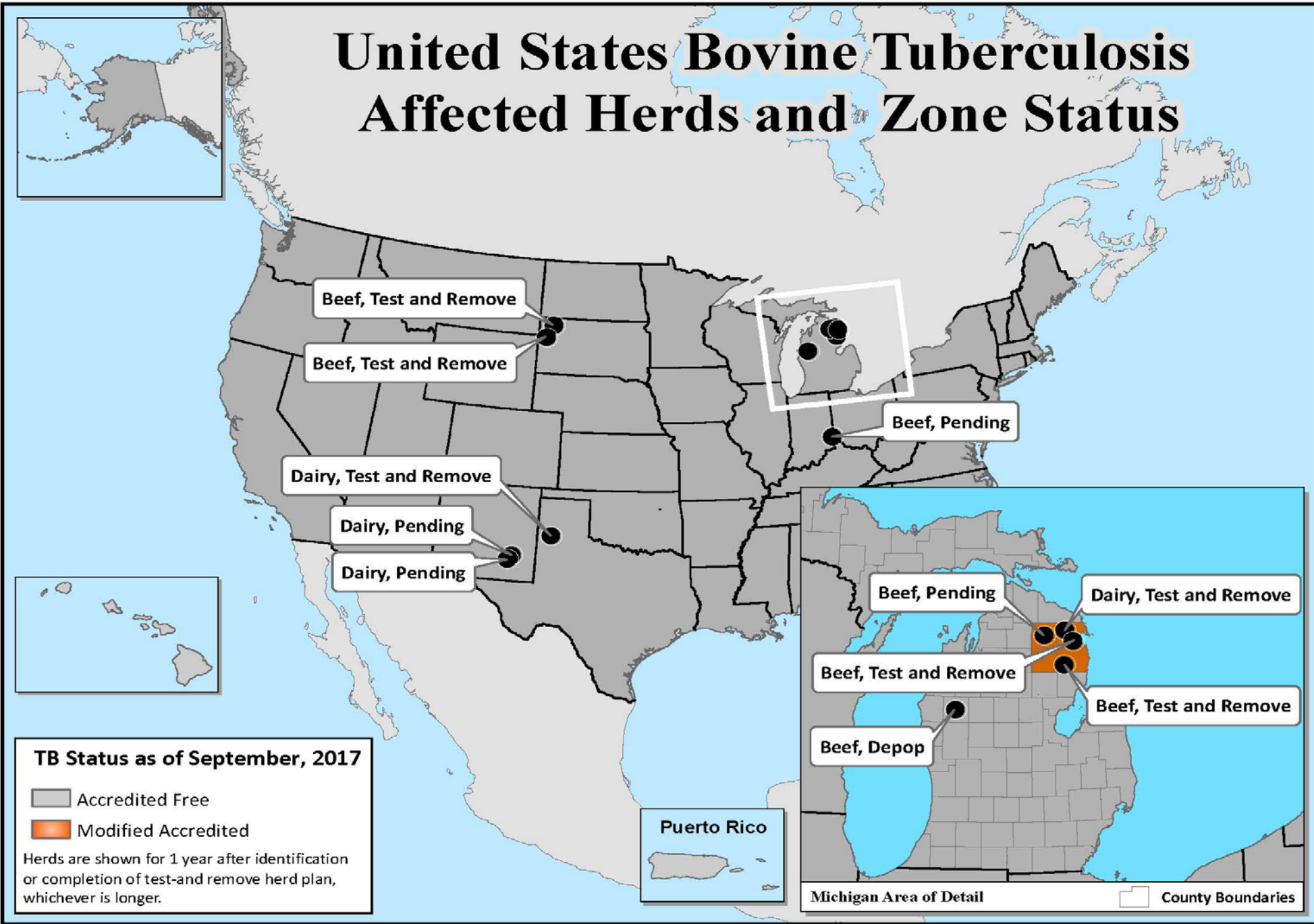
An investigation into the source of a TB infected Holstein steer detected during routine inspection at an Arizona slaughter plant in January 2016 is ongoing. An investigation of cattle moved to California from a TB-affected dairy herd in Texas was completed in December 2015 with no findings of infection in the receiving herds. A TB-infected dairy cow slaughtered in California in November 2013 was investigated in Utah and California.

United States Tuberculosis Zone Status Cattle and Bison

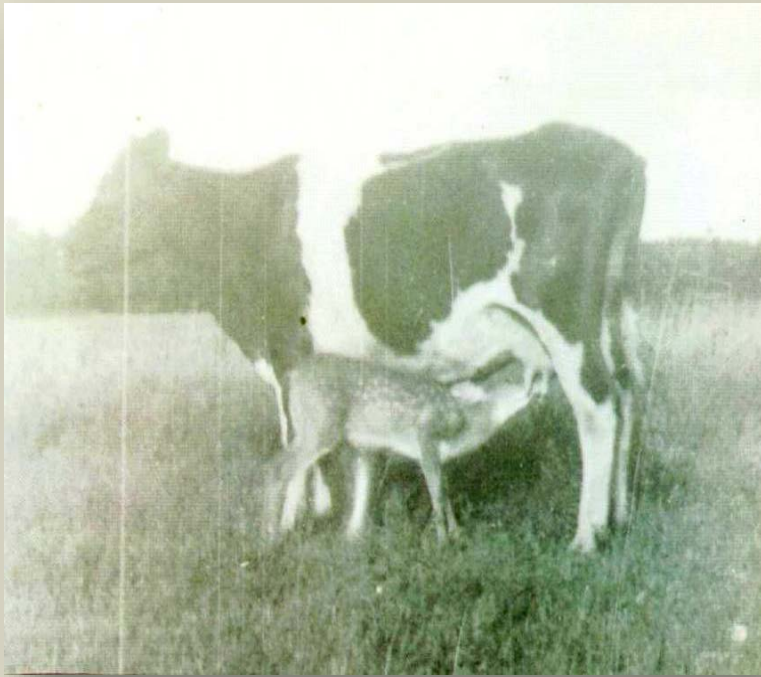
Mid-Late
1990's
bTB
disclosed
endemic
in wildlife
and cattle
herds in
Michigan's
peninsula.



US Bovine Tuberculosis eradication program status September 2017

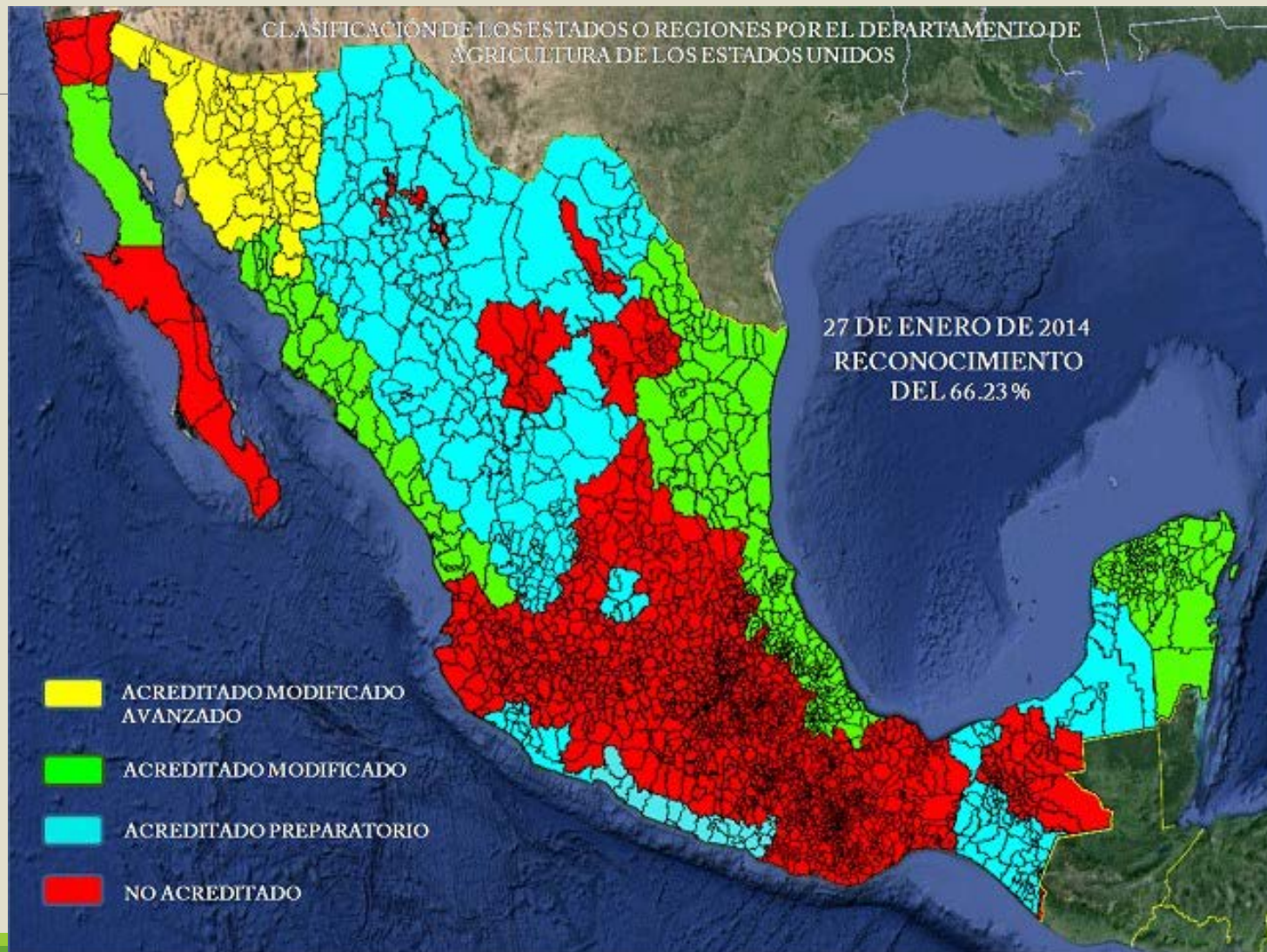


TB in Michigan



2017 bTB Status of Mexico

1990's USDA, Mexico, cattle industry and SAHO's established a Bi-National bTB working group, and working hard with limited resources to accomplish the impossible dream



Ongoing Challenges to US bTB Eradication

Pockets of wildlife infection in upper Midwest-Great lakes region, MI, IN

Undetermined sources of *M bovis* re-introduction (human transmission back to cattle?)

Movement of Mexican origin cattle “roping steers, fat cattle” from state to state

FSIS surveillance resources stretched; line speed increases, small beef plants may not be inspected

New ADT program challenges, traceability, cow buyers resellers, dealers

Cattle industry changes: large scale herds, specialization of industry, calf ranches, heifer raisers, cattle trade over vast geographic distance

Decreased regulatory budgets; national and state

- National and State Indemnity Programs underfunded



US bTB Eradication Campaign Benefits

- **1917-1962** Estimated Annual benefits exceed **\$98.7 million/yr**

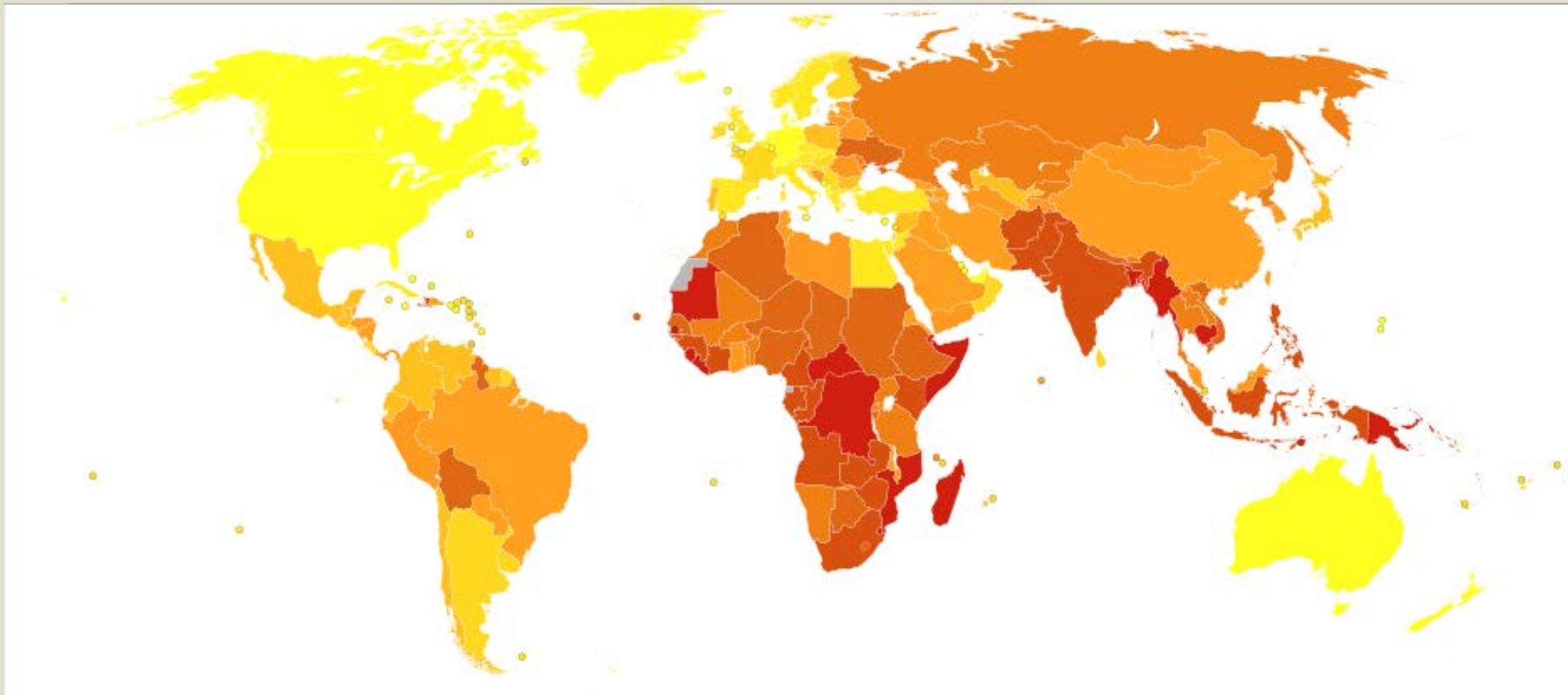
2003 Estimated Benefits

- Savings to the livestock industry **>\$38 Billion in 2003 dollars**
- **By 1941 estimated ~26,000 human lives saved annually.**

Current status: Limited documentation of cattle to human TB transmission within USA:

- Hunter in MI-Wilkins, Melinda J. et al. *“Human Mycobacterium Bovis Infection and Bovine Tuberculosis Outbreak, Michigan, 1994–2007.”* *Emerging Infectious Diseases* 14.4 (2008): 657–660. PMC. Web. 26 Jan. 2017.
 - One Health TB studies needed involving farmers and dairy workers on outbreak farms.
 - No documented cases to the public by consumption of USA dairy products in recent memory.
 - Good evidence involving dairy products and immigrants from other countries.
-
- It is estimated that the bTB eradication program, along with pasteurization, **prevent > 25,000 human deaths annually!**

Human Mortality TB per million population



Phylogenetics- old school based on:

- Host species affected

Over time Microbiology of pathogen;

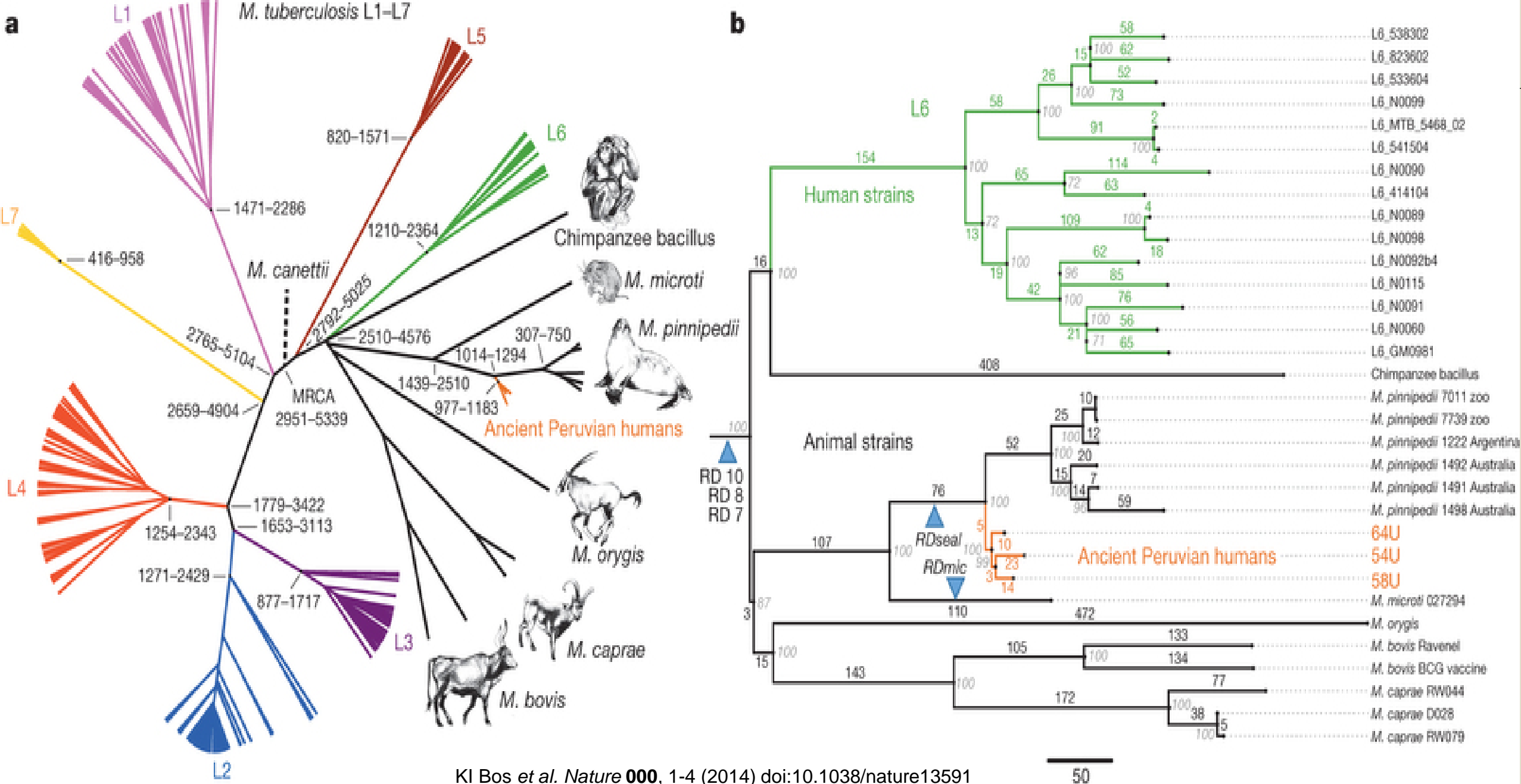
- Culture,
- Biochemical analyses, then
- gene probes, and now
- Whole Genomic Sequencing (WGS)

TABLE 1
Classification of Mycobacteria That Often Cause Infections
in Humans (Runyon, 1959)*

| |
|--|
| <i>M tuberculosis</i> complex |
| <i>M tuberculosis</i> |
| <i>M bovis</i> |
| <i>M africanum</i> |
| <i>M leprae</i> |
| Slow growing mycobacteria (more than 7 days) |
| <i>M kansasii</i> (photochromogens, Runyon Group I) |
| <i>M marinum</i> |
| <i>M gordonae</i> (scotochromogens, Runyon Group II) |
| <i>M scrofulaceum</i> |
| <i>M avium</i> complex (nonchromogens, Runyon Group III) |
| <i>M avium</i> |
| <i>M intracellulare</i> |
| <i>M scrofulaceum</i> |
| <i>M terrae</i> complex |
| <i>M ulcerans</i> |
| <i>M xenopi</i> |
| Rapidly growing mycobacteria (Runyon Group IV) |
| <i>M fortuitum</i> |
| <i>M chelonae</i> |
| <i>M abscessus</i> |

**M* indicates *Mycobacterium*.

Runyon EH. Anonymous mycobacteria in pulmonary disease. Med Clin North Am. 1959;43:273-90. Taken from Griffith y Wallace.⁷



NVAP, TB Qualified Accredited Veterinarians, One Health

Cattle Program-Well established in regulations, prevalence low,

Captive Cervidae – 1999 UMR

- Include deer, elk, caribou (reindeer)
- Single Cervical Test (SCT)
 - Only administered by Qualified Accredited Veterinarians (QAVs)
 - Wait 90 days to retest

Elephants, swine, camelidae, other exotic mammalian species,

Humans & One Health



The cover of a document titled "Tuberculosis Surveillance Plan for Non-Domestic Hoofstock". It features six line drawings of different hoofstock animals: a deer, a bighorn sheep, a mule, a goat, a rhinoceros, and a pronghorn. The text on the cover includes:

**Tuberculosis Surveillance Plan
for Non-Domestic Hoofstock**

Developed by
The National Tuberculosis Working Group
for Zoo and Wildlife Species
October 2001

Endorsed by
American Association of Zoos and Aquariums
American Association of Zoo Veterinarians
USAHA Tuberculosis Committee
U.S. Department of Agriculture

Thomas Wolfe-Childhood

Born October 3rd 1900, when TB was the leading cause of death in the US, and worldwide.

Parents: William Oliver Wolfe and Julia Elizabeth Westfall.

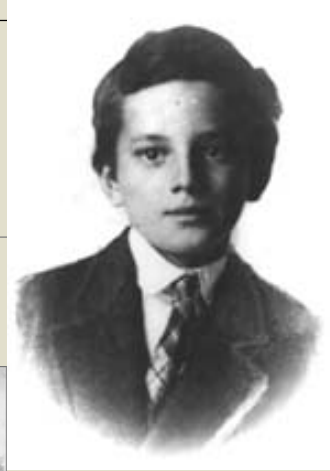
7 older siblings, many died in early childhood.

Tom's mom ran a boarding house 2 blocks from family home in Asheville, NC.

Tom lived with his mom at boarding house from age 6, until he went away to college at age 15.

Many TB infected boarders moved to Asheville for the "climatic cure"

Ultimately 25 Sanitariums in Asheville, but boarding houses were cheaper and more comfortable. It is believe Tom was exposed there, while very young.



Thomas Wolfe-Work life

The fear of early death was on his mind.

He knew that he could never write all that he wanted too.

He wrote continuously...

He became obsessed with writing, stress, and neglected rest and sleep...



Thomas Wolfe 1900-1938



1900 was the year of author Thomas Wolfe's birth, when TB was the most dreaded disease throughout the world and the leading cause of death in the United States.

from Look Homeward, Angel

“A destiny that leads the English to the Dutch is strange enough; but one that leads from Epsom into Pennsylvania, and thence into the hills that shut in Altamont over the proud coral cry of the cock, and the soft stone smile of an angel, is touched by that dark miracle of chance which makes new magic in a dusty world. Each of us is all the sums he has not counted: subtract us into nakedness and night again, and you shall see begin in Crete four thousand years ago the love that ended yesterday in Texas. The seed of our destruction will blossom in the desert, the alexin of our cure grows by a mountain rock, and our lives are haunted by a Georgia slattern, because a London cutpurse went unhung. Each moment is the fruit of forty thousand years. The minute-winning days, like flies, buzz home to death, and every moment is a window on all time...”

This is a moment ”

- One of the great novelists of the 20th Century.
- Died at the age of 37 of Tuberculosis
- A few of the many other great literary and historical figures that have been known to have died from TB:
 - John Keats
 - Percy Shelley
 - Elizabeth Barrett Browning
 - Robert Louis Stevenson
 - Henry David Thoreau
 - Emily and Charlotte Bronte
 - Anton Chekov
 - F. Scott Fitzgerald. TB
 - Doc Holliday

By 2017 the centennial anniversary of the 1917 program had decreased bovine prevalence from 5% to $<0.001\%$. Today, years of hard work by industry, veterinarians, researchers and animal health regulatory officials, have together created a program with a net benefit of almost \$160 million per year, and un-measured human lives saved.



Key References:

*An Impossible Undertaking: The
Eradication of Bovine Tuberculosis in the
United States*

ALAN L. OLMSTEAD AND PAUL W. RHODE

**Not on My Farm!: Resistance to Bovine Tuberculosis Eradication
in the United States**

Alan L. Olmstead
and
Paul W. Rhode

SAGE-Hindawi Access to Research
Veterinary Medicine International
Volume 2011, Article ID 816345, 12 pages
doi:10.4061/2011/816345

Review Article

**Bovine Tuberculosis and the Establishment of an Eradication
Program in the United States: Role of Veterinarians**

Mitchell V. Palmer and W. Ray Waters