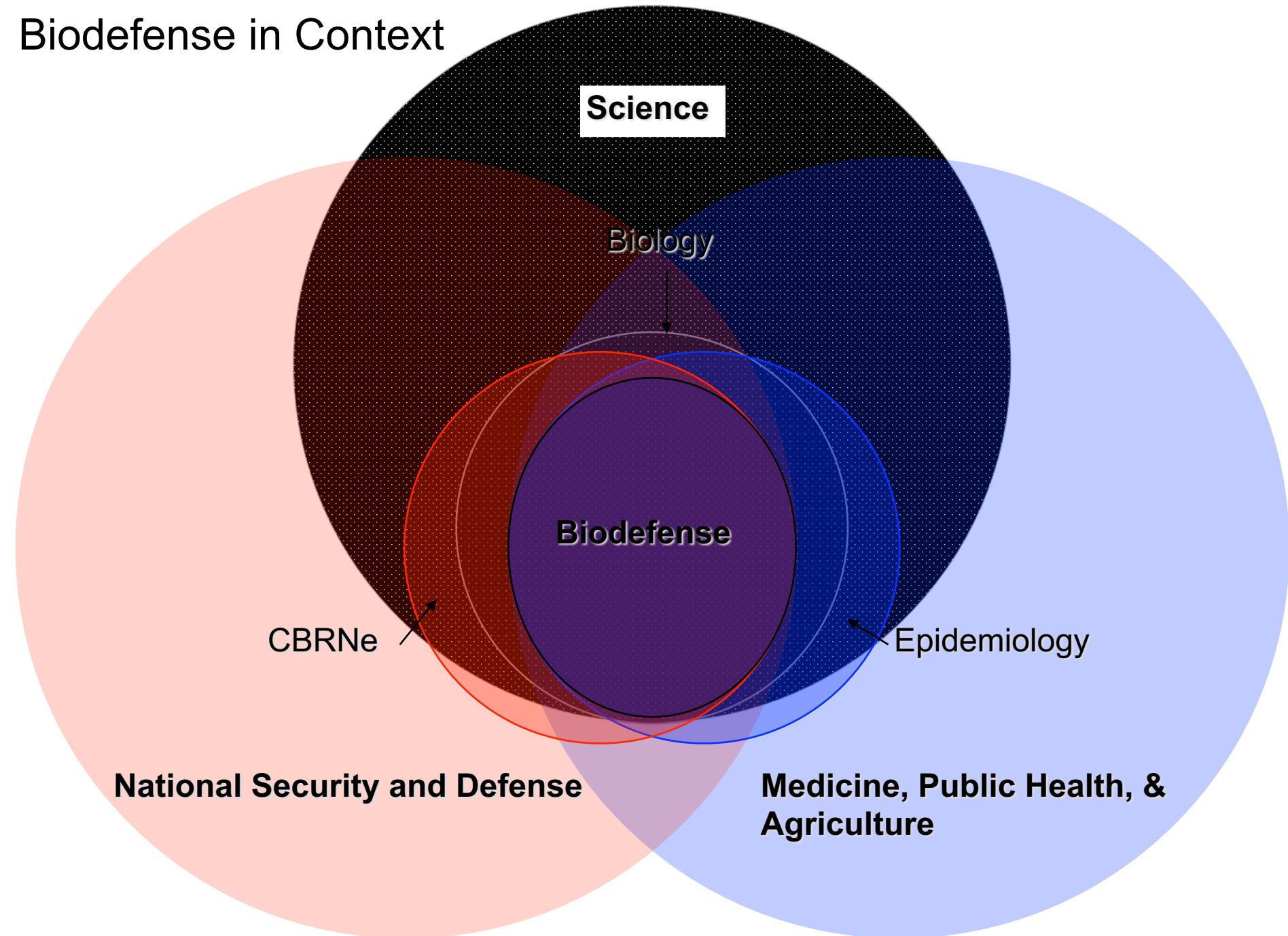


What is Biodefense?

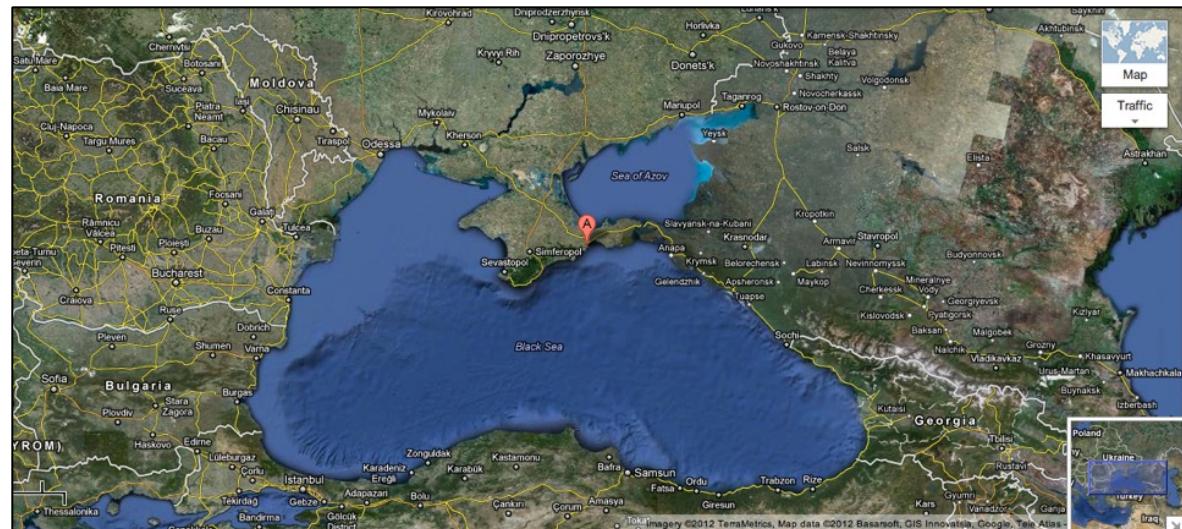
- Biodefense refers to the procedures and countermeasures involved in taking defensive measures against attacks on people, animals, or crops using biological agents, aka ***bioterrorism*** or ***biological warfare***. Protection of water supplies and food supplies are often a critical part of biodefense.
- Biodefense may include:
 - Biodetection (Environmental monitoring and diagnostics)
 - Biosurveillance (Human, animal, plant, and crop health)
 - Biosecurity (Accidental release and intrusion prevention)
 - Bioforensics (Attribution, forensics and legal prosecution)
 - Bioviolence and Biocrimes (Non-terrorist, non-warfare)
 - Medical Countermeasures (vaccines, antibiotics, etc.)

Biodefense in Context



Historical Context

- Siege of Caffa
- The year 1346 – “first use of Biological Warfare”
- Responsible for spreading the Black Death from Crimea to Europe
- Catapulted bodies of Plague victims into the city



Historical Context

- European Settlement of North America
- In 1763 Lord Jeffrey Amherst purposely distributed Smallpox virus contaminated blankets to American Indians



Historical Context

- President George Washington
- Personal physician recorded in his journal that Washington had Anthrax
- Surgically removed the lesion from his thigh
- Kept secret as a matter of National Security



Biological Warfare in Modern Times

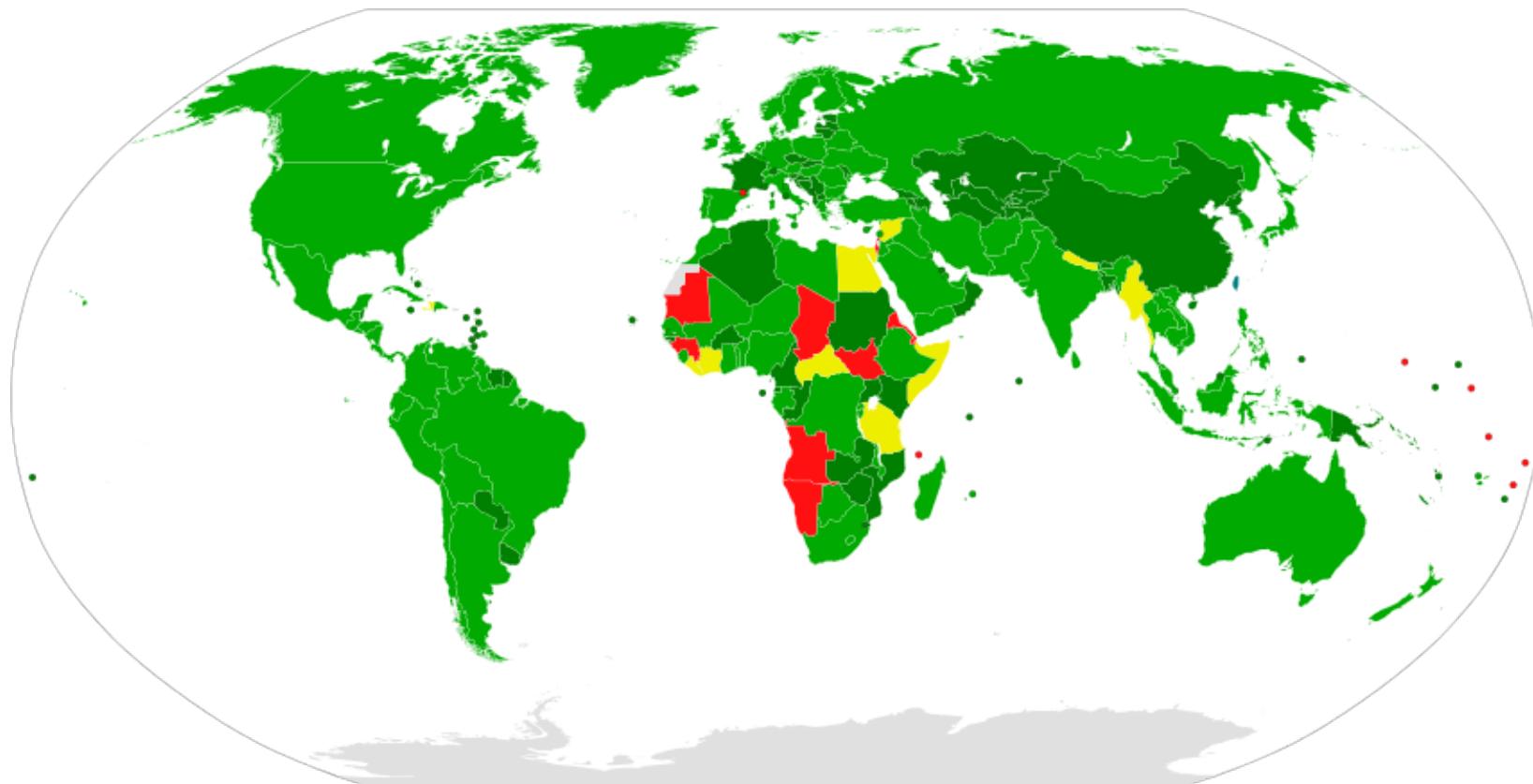
The U.S. had an offensive Biological Warfare program beginning officially in 1943 under President Franklin Roosevelt (unofficially, the U.S. military began experimentation as early as 1918). The official BW program continued until 1969 – President Nixon ordered the halt to offensive research and development.



Biological and Toxin Weapons Convention

- The 1925 Geneva Protocol prohibited use of “asphyxiating, poisonous or other gases, and of all analogous liquids, materials or devices” and “bacteriological methods of warfare.”
- The BTWC was opened for signature in 1972 and entered into force in 1975
- The Convention bans the development, production, stockpiling, acquisition and retention of microbial or other biological agents or toxins, in types and in quantities that have no justification for prophylactic, protective or other peaceful purposes.

Participation in the BTWC



Participation in the Biological Weapons Convention

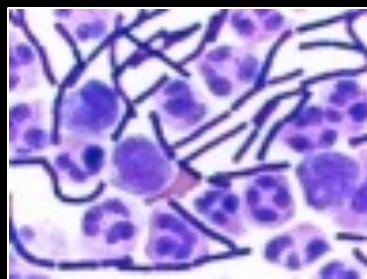
- █ Signed and ratified
- █ Acceded or succeeded
- █ Unrecognized state,
abiding by treaty
- █ Only signed
- █ Non-signatory

Biological Warfare

- On the battlefield the *threat* of BW may be as effective (or more!) as actual use if the enemy objective is to hinder and consume resources
- Control of BW agent after release is problematic because of drift and if it is infectious
- Attack on agricultural targets could be potentially more devastating, at least economically



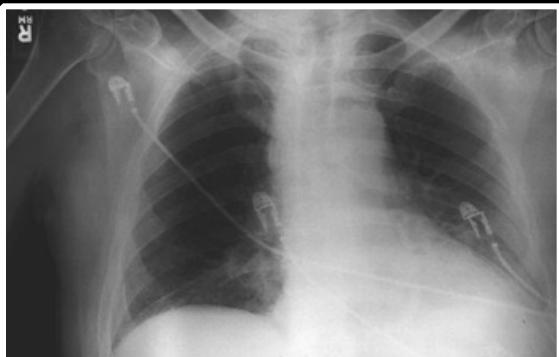
ANTHRAX AND BIOTERROR

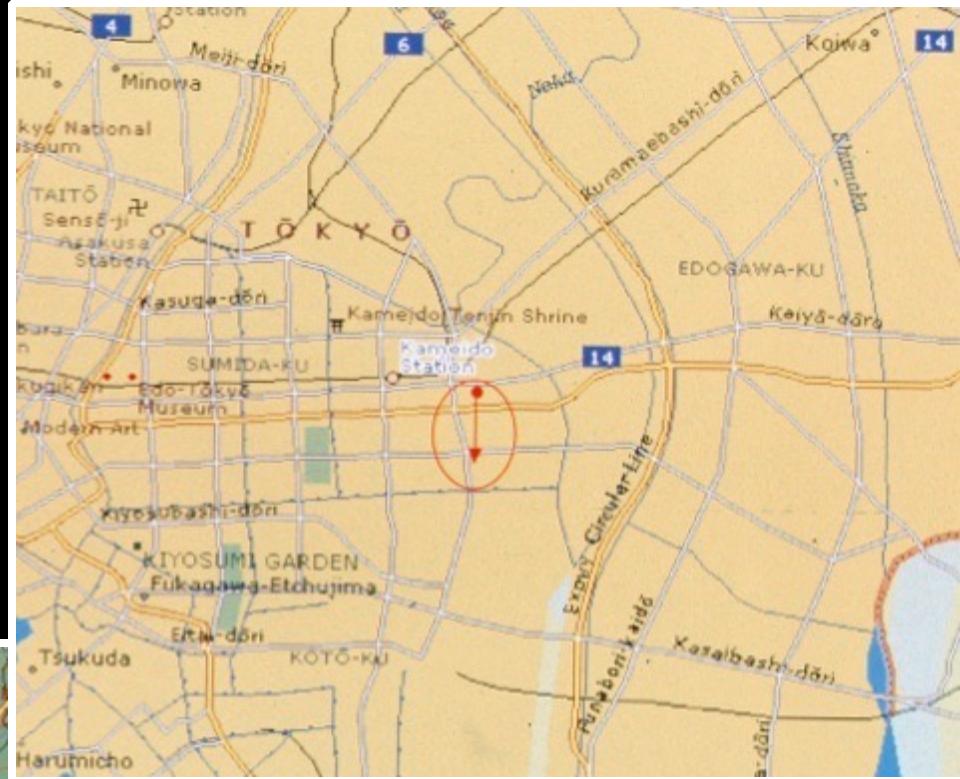


CSF smear

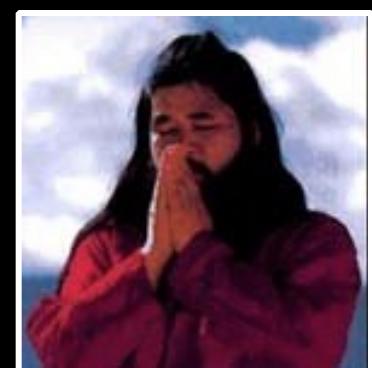
American Media
Building

Thoracic Radiograph
with Mediastinal widening





Aum Shinrikyo Anthrax Attack 1993



Aum leader Chizuo Matsumoto
aka Shoko Asahara



Amerithrax

- The total cost of Amerithrax is incalculable
- 5 deaths and 24 infected person (known)
- Perpetrator(s) were/have not been prosecuted

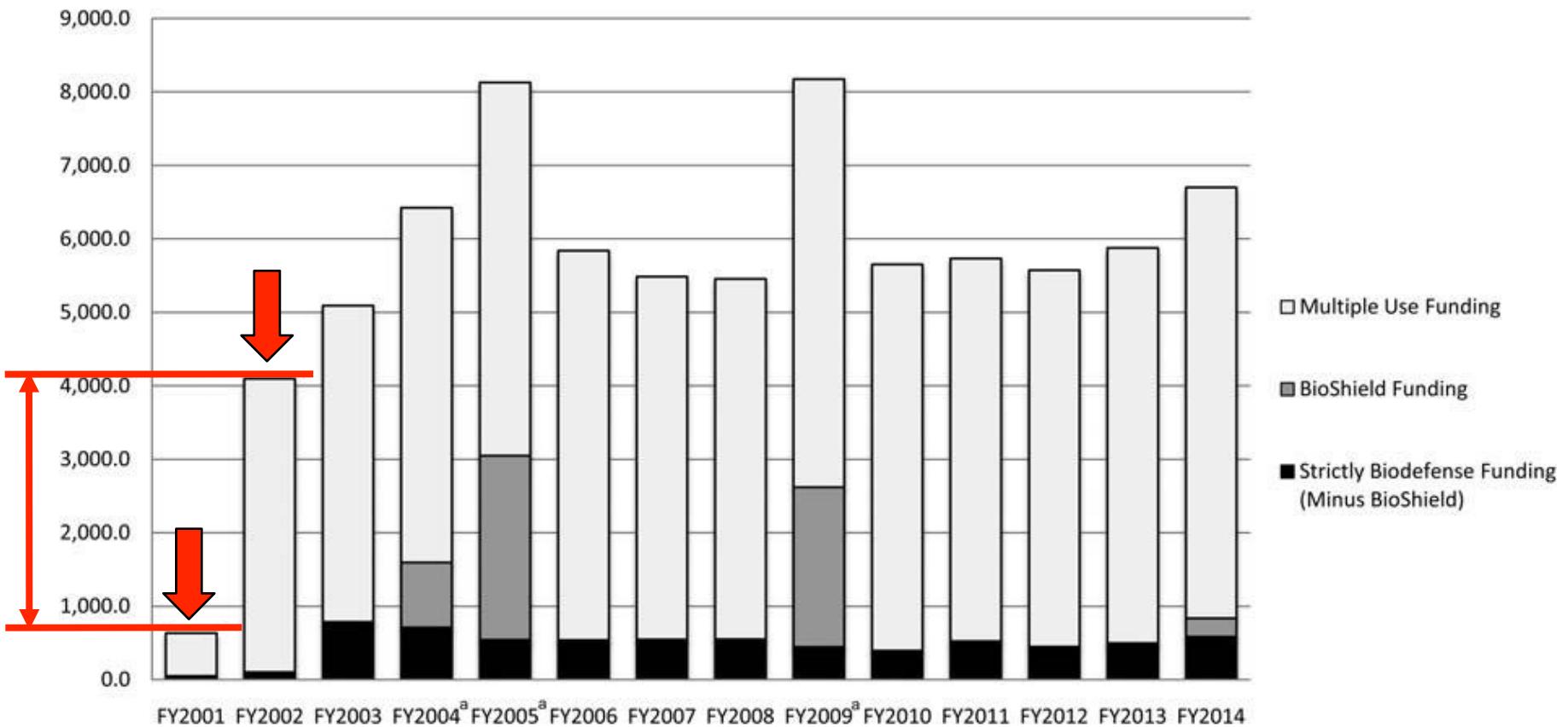


Bruce Ivins

- April 22, 1946 – July 29, 2008
- FBI concluded that Dr. Ivins was solely responsible for the the Amerithrax Anthrax Attacks
- No charges filed
- Dr. Ivins died of an overdose of Tylenol

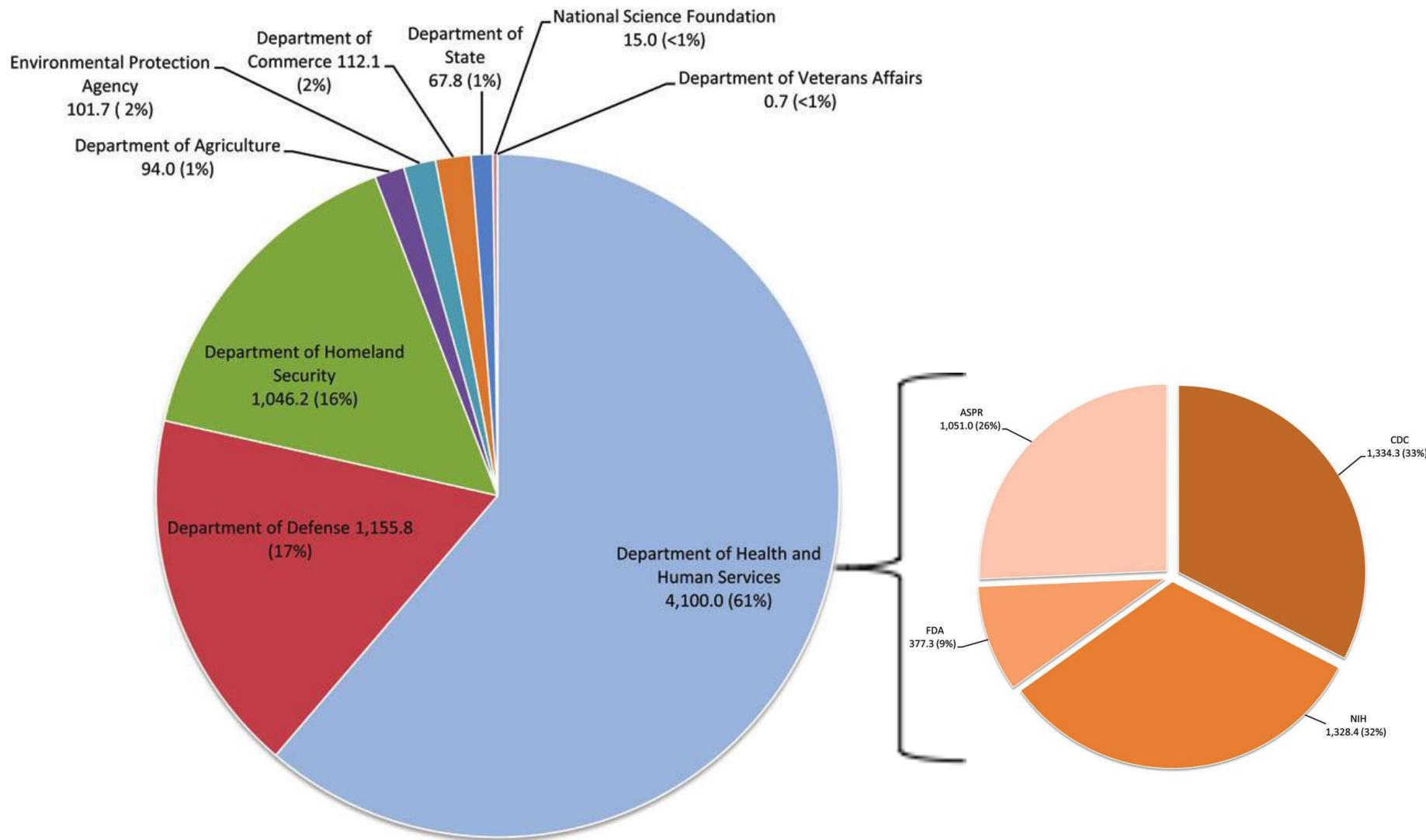


Biodefense Spending 2001 - 2014



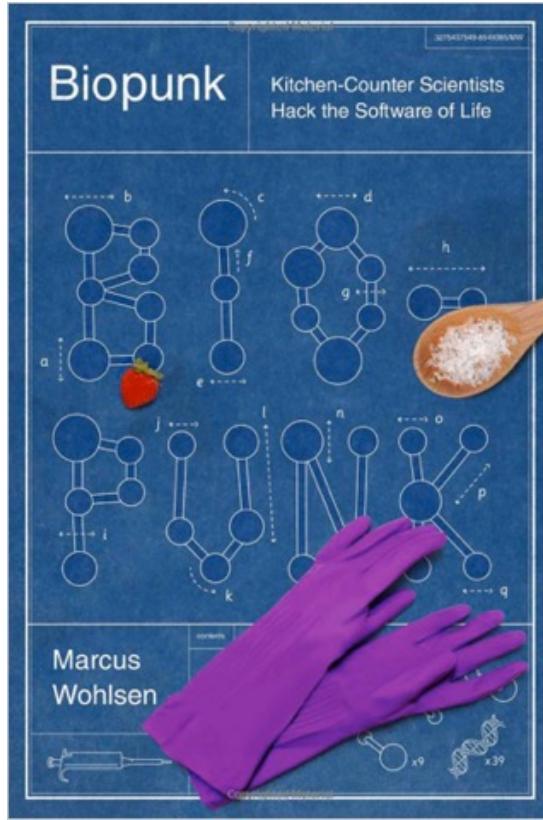
^aA total of \$5.6 billion was appropriated to a Project BioShield Special Reserve fund in FY2004. Of the \$5.6 billion fund, \$885 million and \$2.507 billion were allocated to DHS in FY2004 and FY2005, respectively, and were obligated for use through FY2008. \$2.175 billion in BioShield was allocated to DHS in the FY2009 budget and obligated for use through FY2013. In 2010, the balance of the SRF was transferred to HHS.

Civilian Biodefense Funding by Agency, FY2014 (in \$millions)



Is DIY Bio and Synthetic Biology Tomorrow's Threat? Or Today's?

The Cat is Out of the Bag



Do-it-yourself: Cathal Garvey, 26, poses in the biology laboratory he created in his mother's spare bedroom. – *MIT Technology Review* 2/13/12

Bacillus anthracis



Causative agent of Anthrax

Gram positive

Rod shaped

Grows in chains

Forms spores

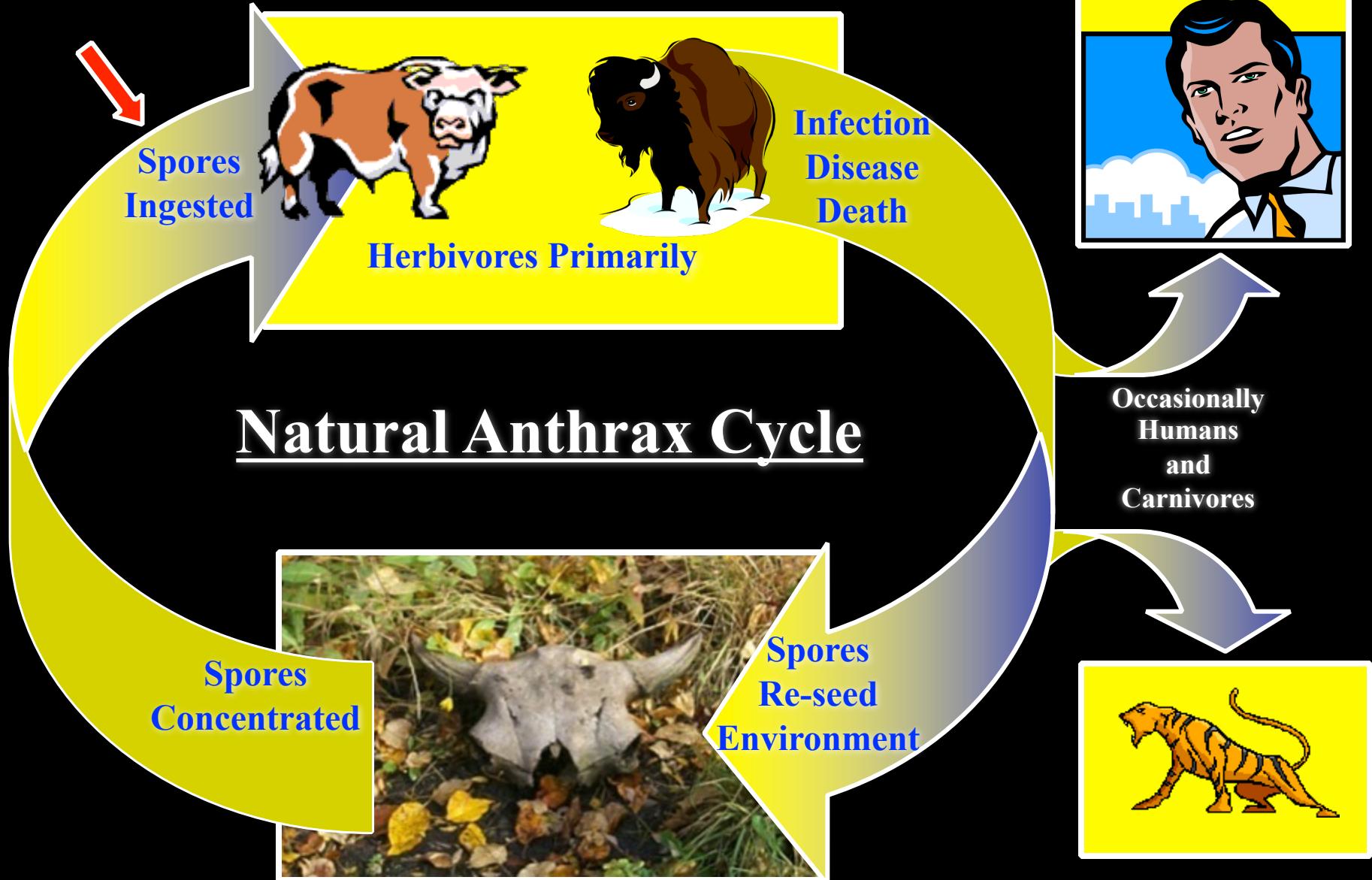
Aerobic

Circular 5.2 Mb
chromosome

Two large virulence plasmids
called pXO1 and pXO2

Typical Anthrax Clinical Presentation

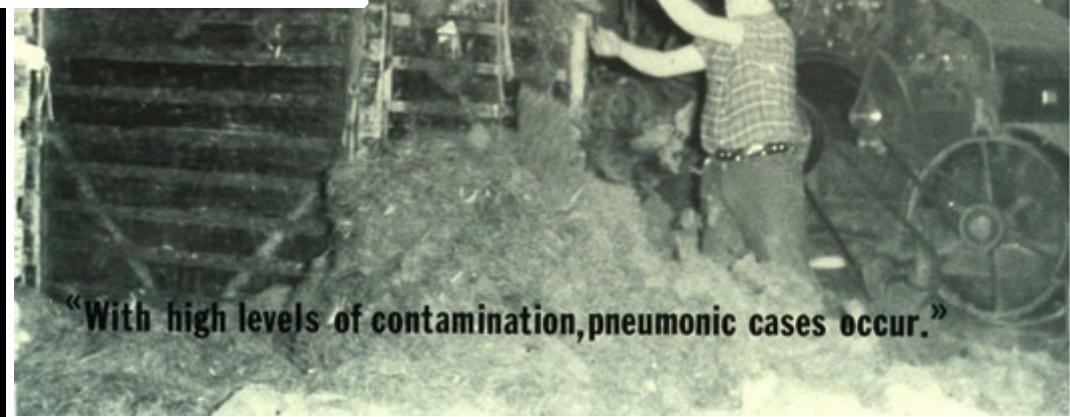
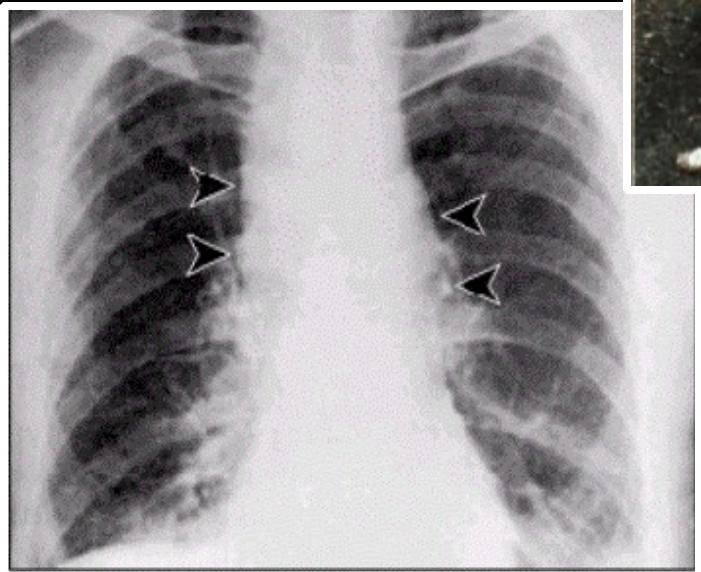
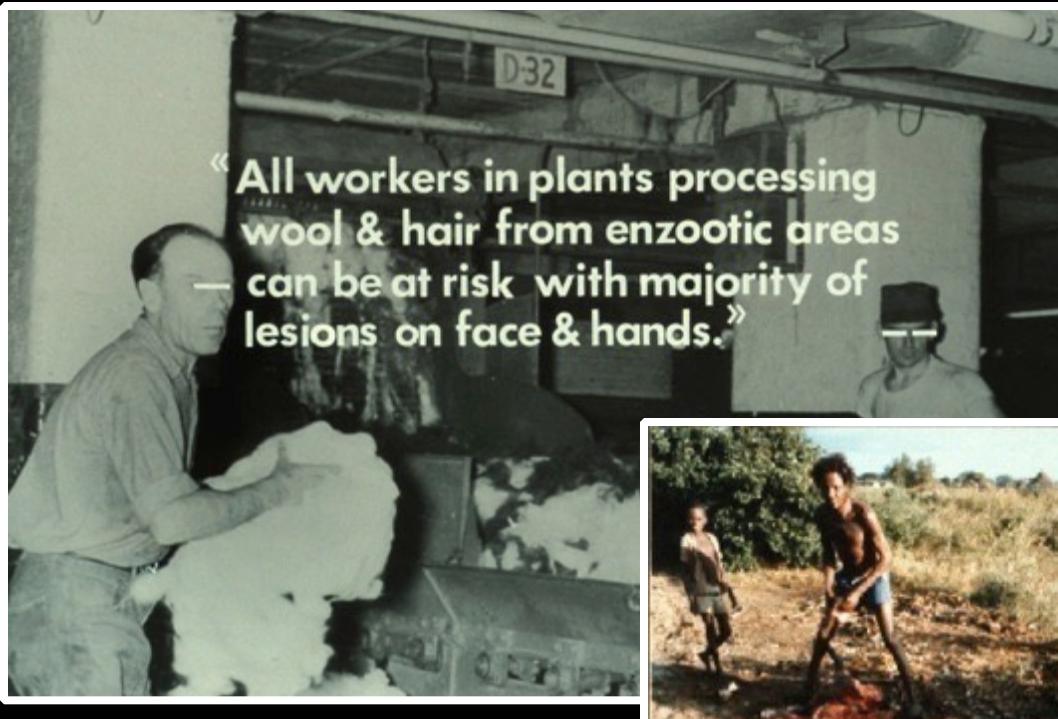




Anthrax is a Disease of Wildlife and Domestic Animals

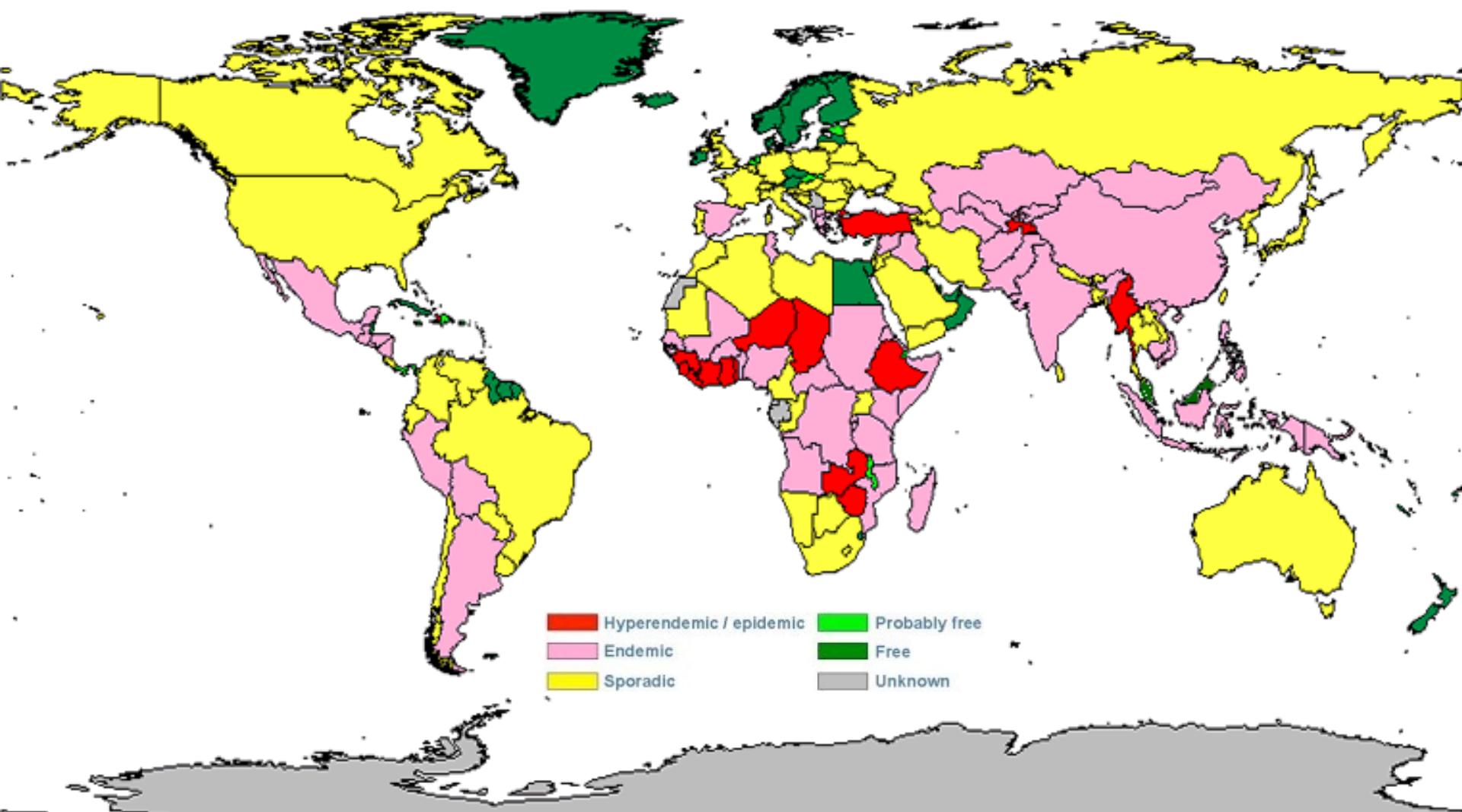


Human Anthrax: Cutaneous, Inhalation and Gastrointestinal



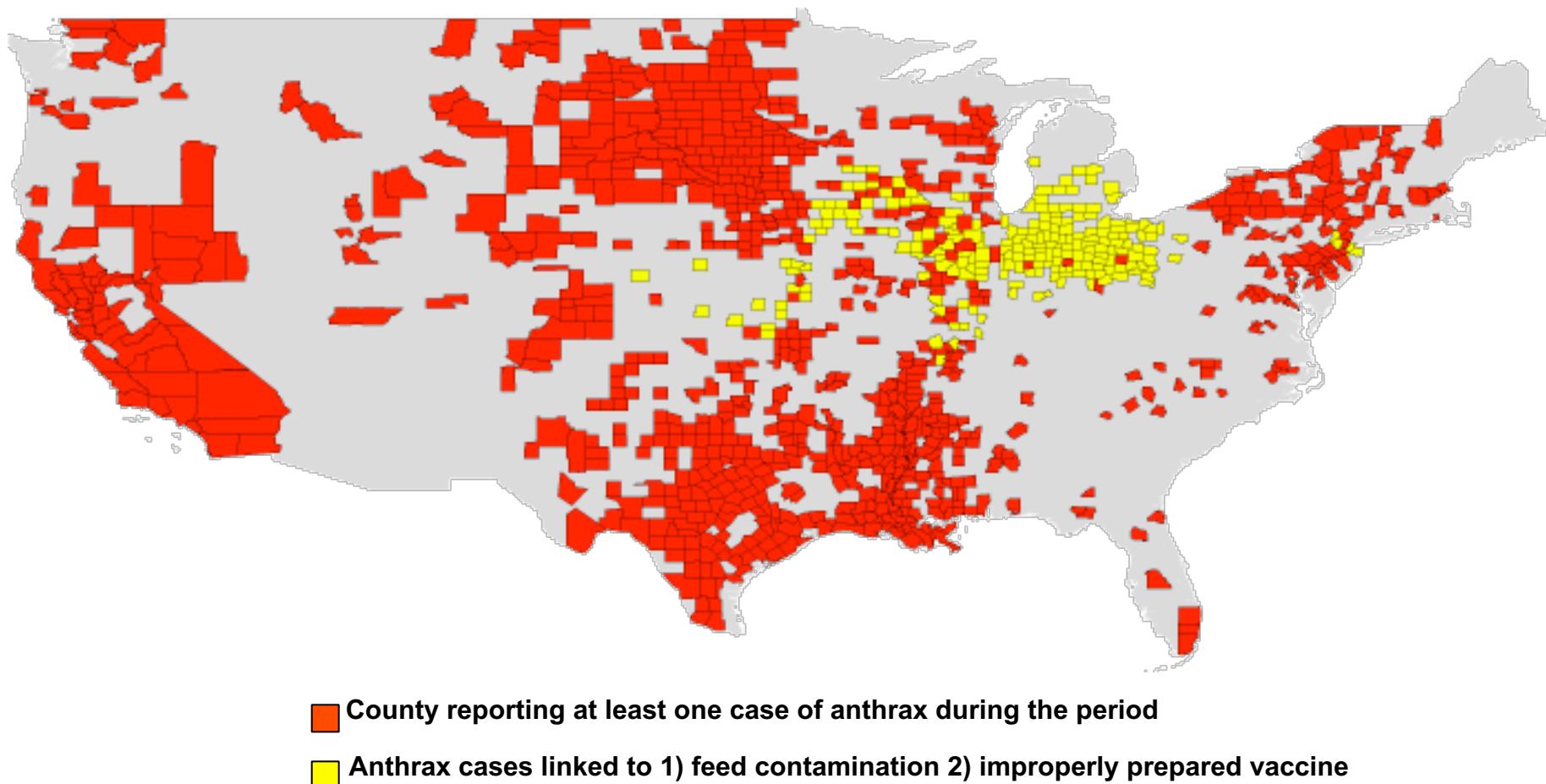
Global Occurrence of Anthrax

WHO Collaborating Center on Remote Sensing and GIS for Public Health
(http://www.vetmed.lsu.edu/whocc/mp_world.htm)



Anthrax Occurrence in the USA 1900 – 2001

Livestock, wildlife and humans



Nevada Counties with Anthrax

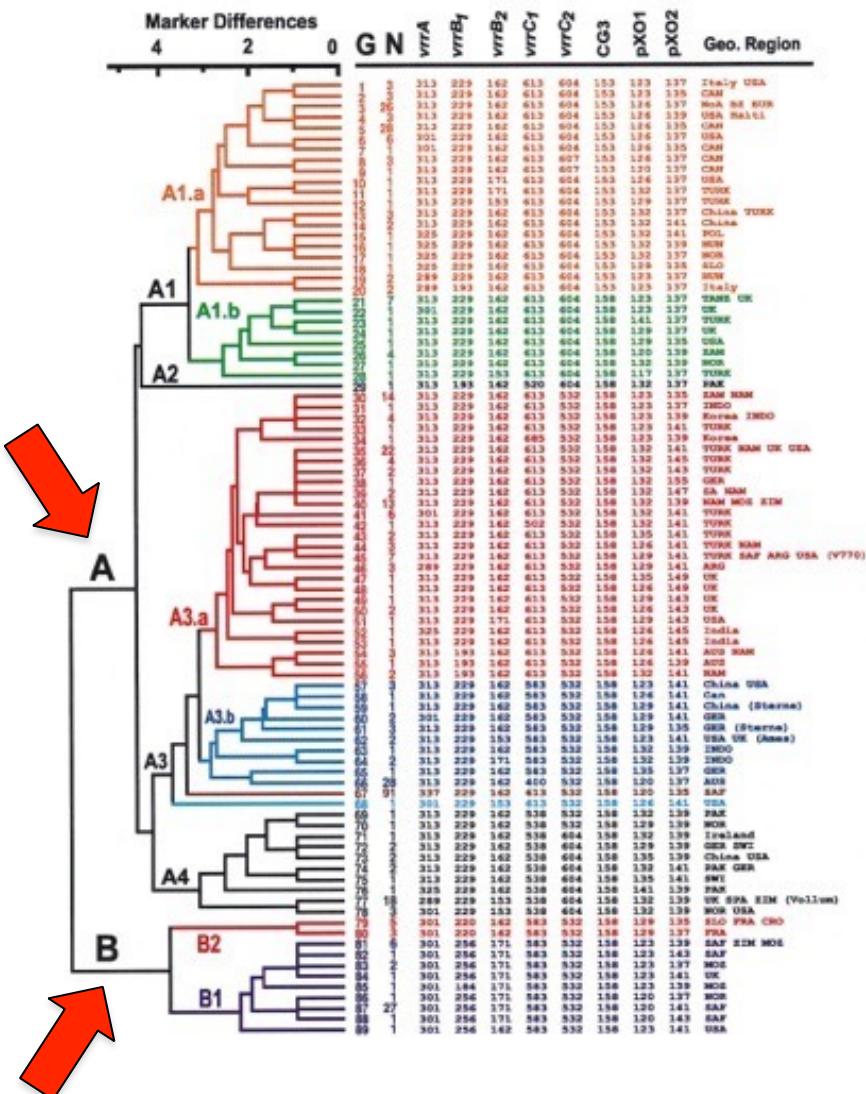


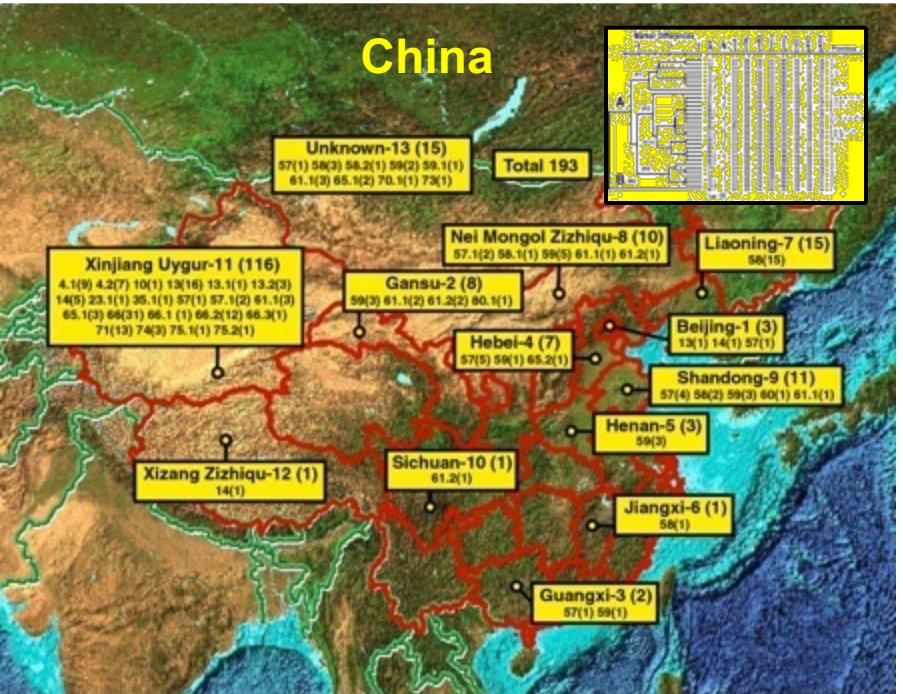
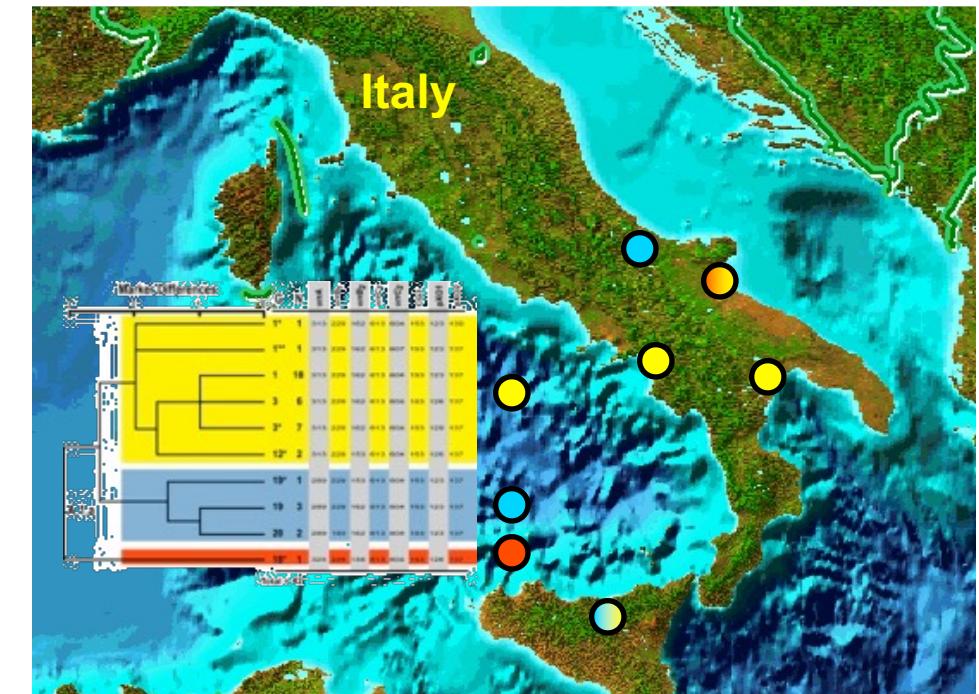
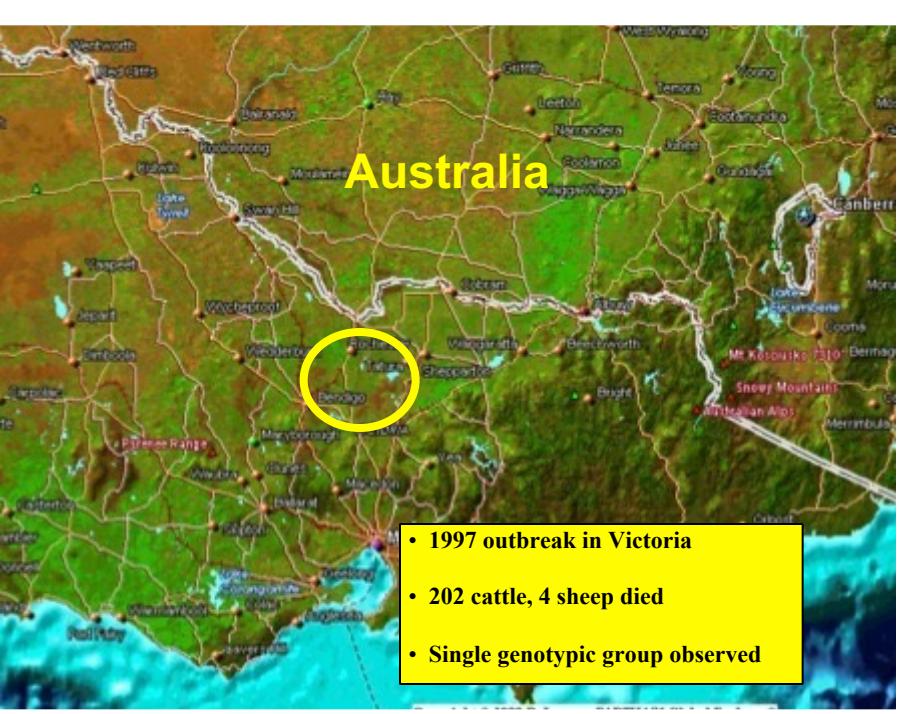
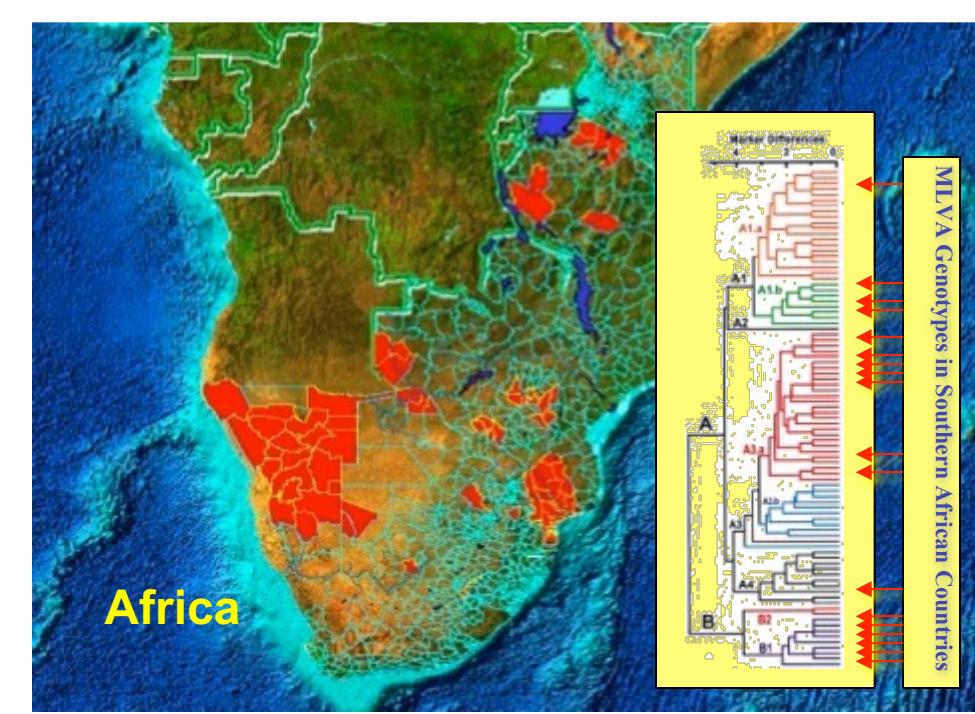
Unique Genotypes of *B. anthracis*

2932 KIM ET AL.

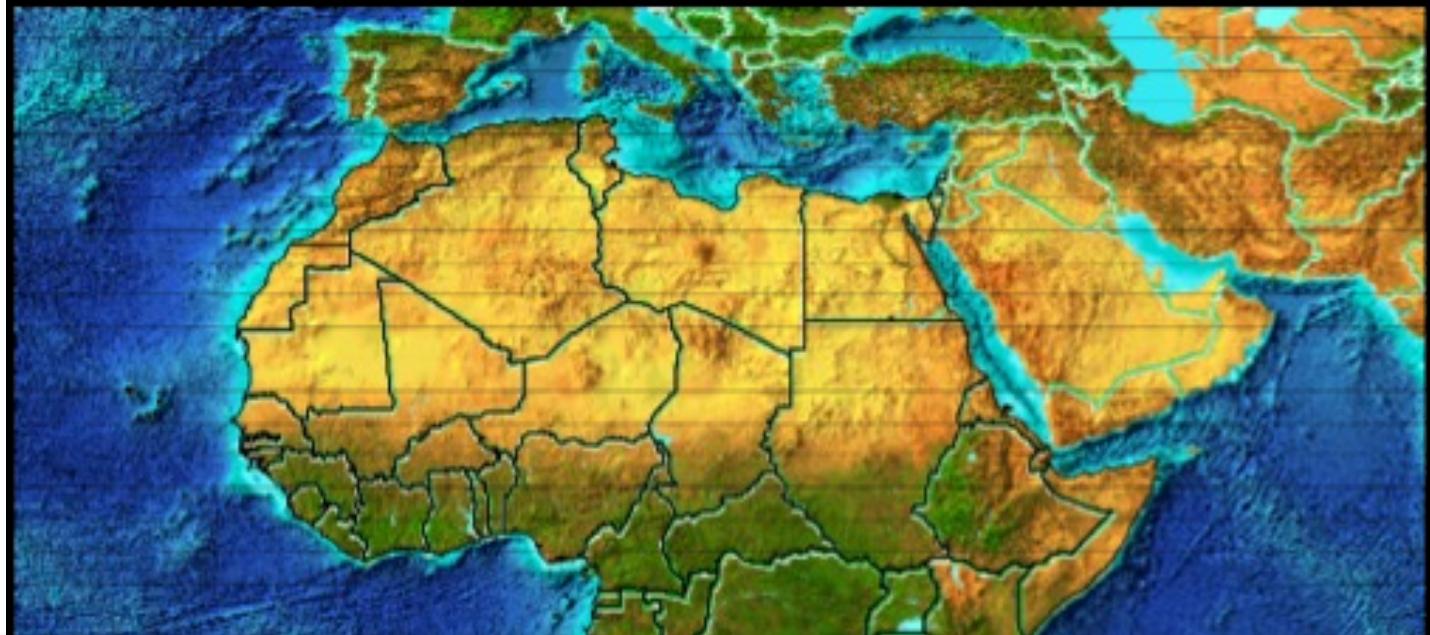
J. Bacteriology

- Multi-locus VNTR Analysis (MLVA)
 - 8 VNTR markers
 - Resolves a worldwide collection of *B. anthracis* isolates into 89 unique genotypes
 - UPGMA dendrogram (tree) shown here



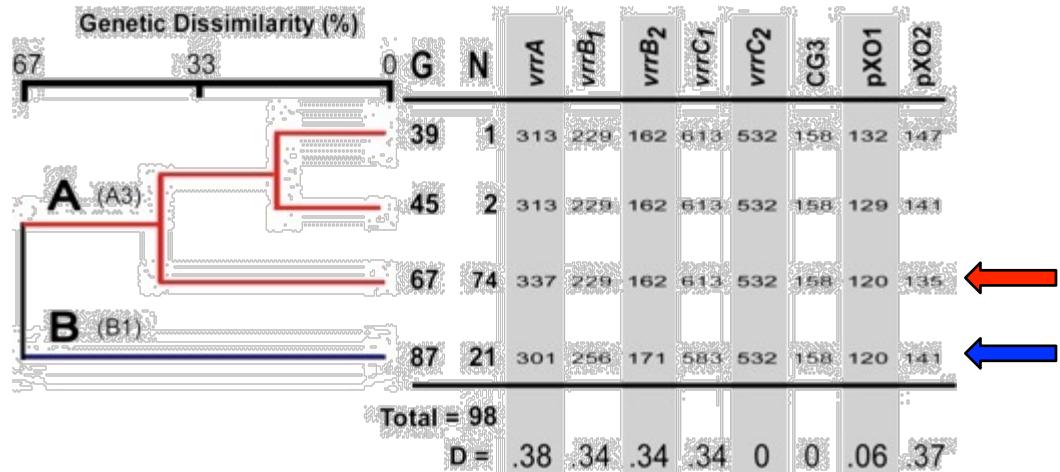


Kruger National Park



7,580 sq mi
– bigger than Connecticut
– just smaller than Massachusetts
Entirely game-fenced

Genotypic Groups of *B. anthracis* in the Kruger National Park



**Geographic distributions of
the two genotypic groups
are overlapping but distinct**

