

# Scientific Approaches to the 2001 Anthrax Letters Investigation

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# 18 September 2001 Mailings



New York Post Envelope



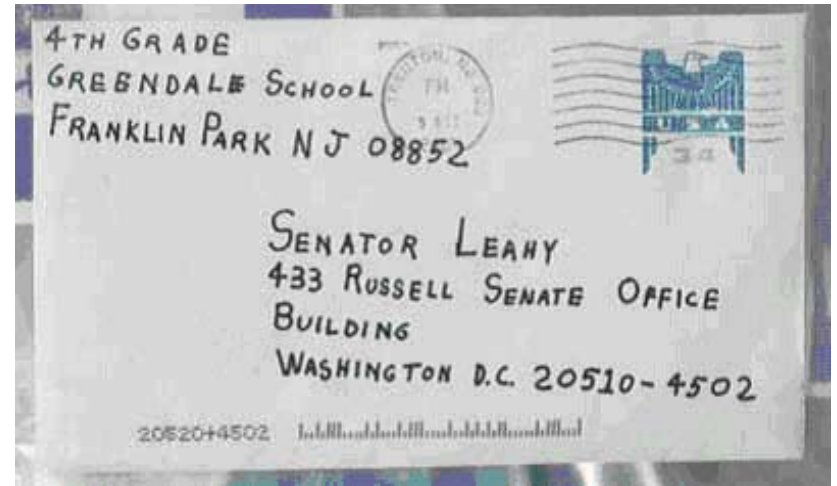
Brokaw-envelope-front



# 9 October 2001 Mailings



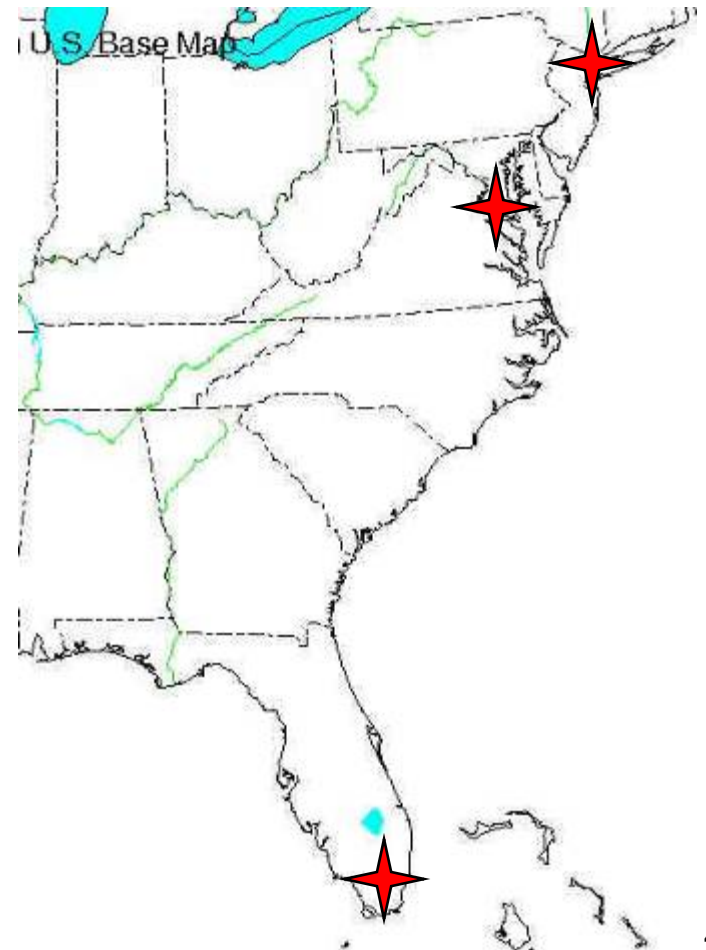
Daschle-envelope-front





# The Anthrax attacks of 2001

- All transmitted by U.S. mail
- 22 human cases of anthrax
- 5 deaths
- Billions of dollars in economic damage





## New York Post Letter Powder

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- Granular in appearance, brown color, crystals and cell debris noted among the *B. anthracis* spores.





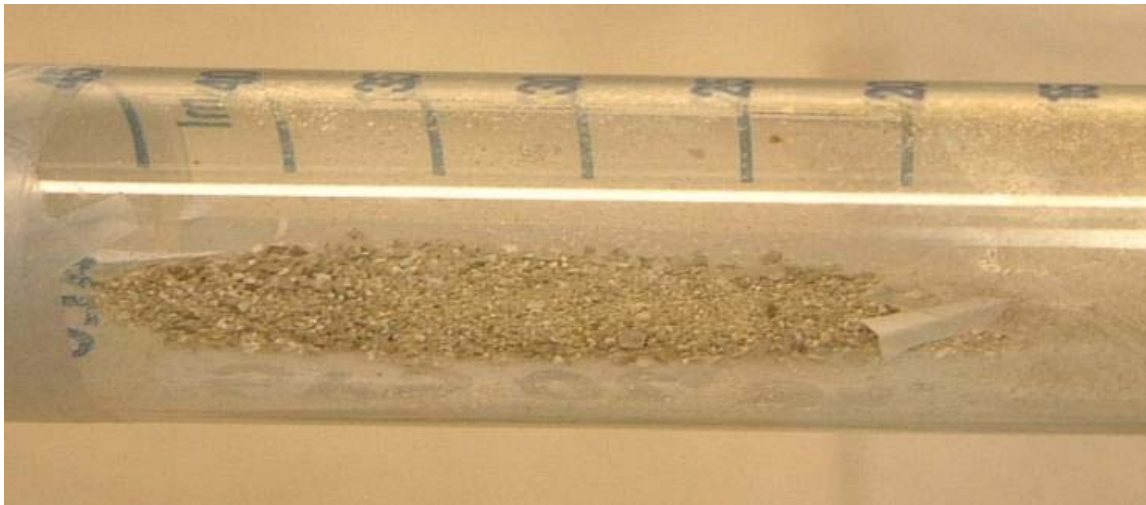
## Leahy Letter Powder

- Powder in the DC mailings was different in texture and color from the NY mailings.
- Higher purity of spores (less cell debris).





## Two distinct growth batches





## Analyses Of Elemental Composition

**Red = Stain**

**Pb, U, C ...**

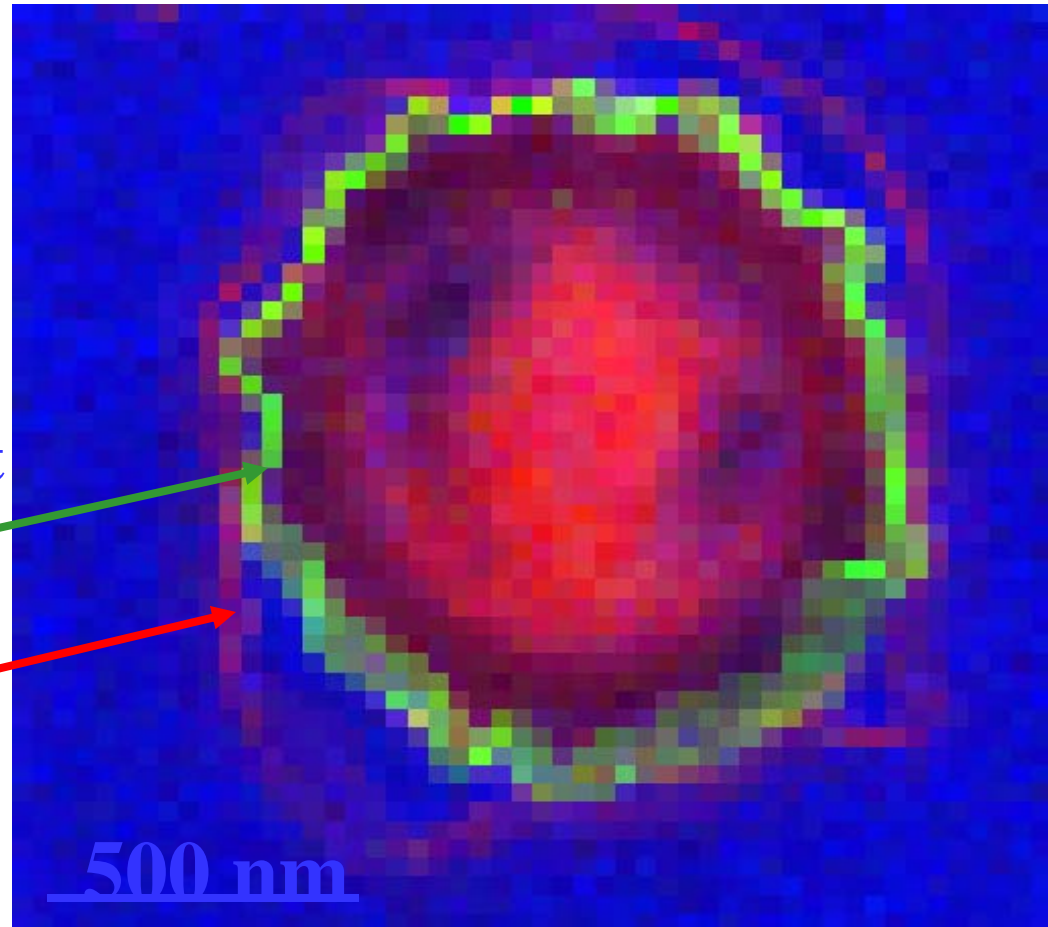
**Green = Coating**

**Si, O, Fe...**

**Blue = Carbon in  
spore and support**

**Spore coat**

**Exosporium**



RGB composite image of the component images from the automated x-ray spectral image analysis of spore from the Daschle-letter material sample SPS02.57\_E (SI2 1500nm).

*Joseph Michael, SNL*





## Other chemical signature tests

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- Stable Isotope Ratio Mass Spectrometry
  - Geolocation
- Accelerator Mass Spectrometry  $^{14}\text{C}$  Analysis
  - Chronology



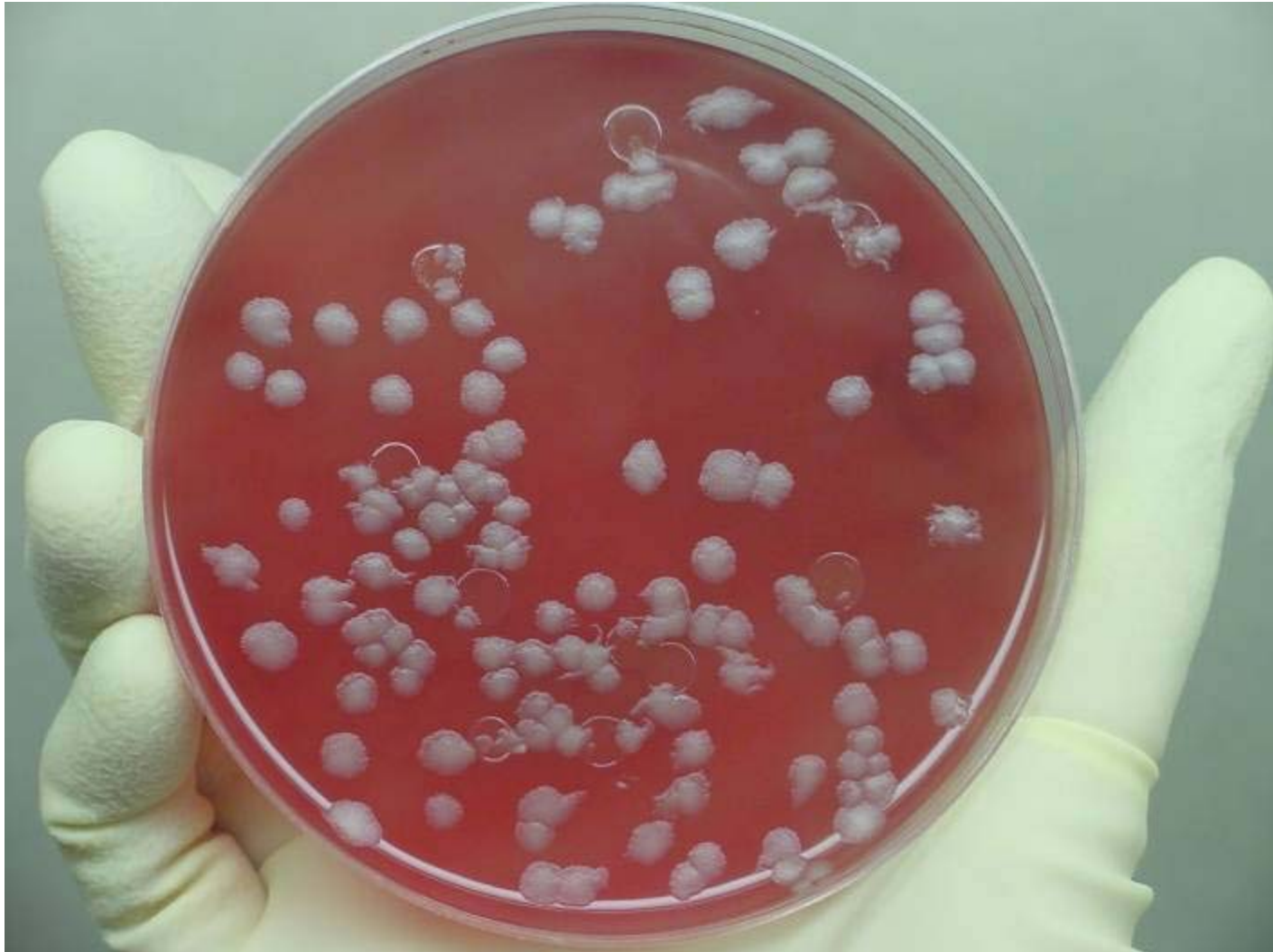
## Genotyping *B. anthracis* using VNTR sites

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- **Keim, P. et al. Molecular diversity in *Bacillus anthracis*.**  
J Appl Microbiol. 1999, 87(2):215-7.
  - Variable Number Tandem Repeat typing utilized to differentiate *B. anthracis* strains.
- **Letter material typed as “Ames” strain.**
  - Ames first isolated in 1981 in Texas from a dead heifer.
  - Eventually used as a challenge strain in anthrax vaccine research and development.
  - Ames was never used in the U.S. or Soviet offensive biological weapons programs (circa. 1950-1969)
- **Florida victim strain identified as Ames**



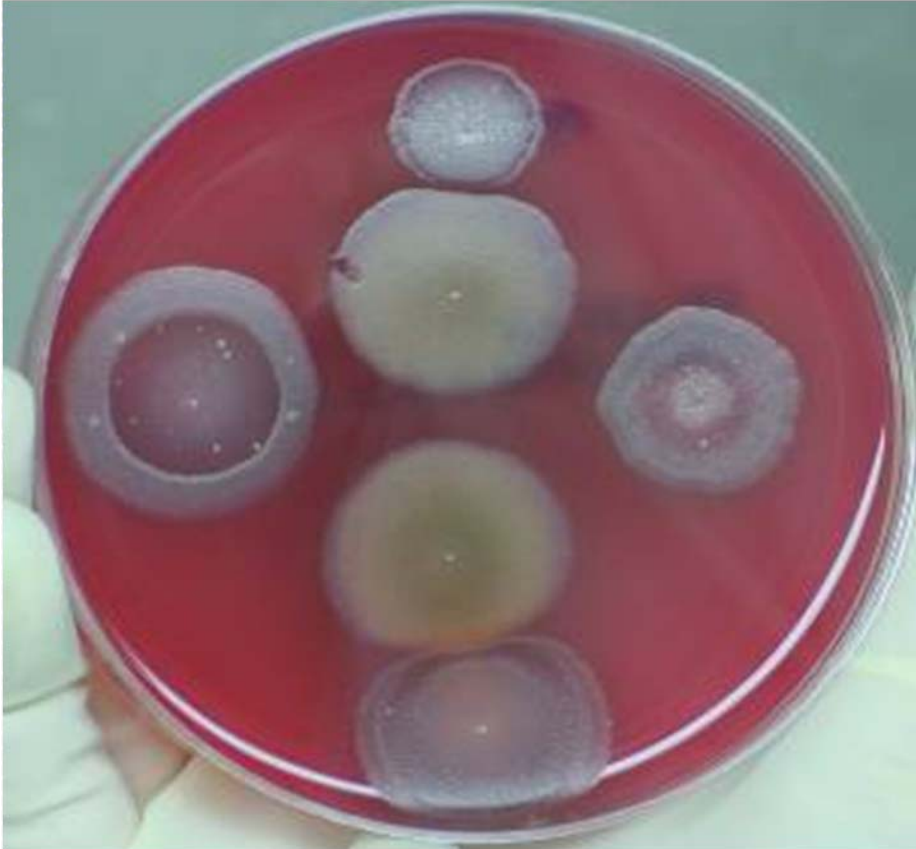
## NY Post powder, diluted and plated





## Phenotypic variants noted

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- Differences in color, morphology, growth rates.



## Time Line

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- Crime Committed: Fall 2001
- Mutants identified: Winter 2001-2002
- Mutants genetically characterized: 2002-2003
- Assays developed and validated: 2003-2006
- All repository collections and examinations completed: mid 2007



# Acknowledgements

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  - Los Alamos National Lab
  - Lawrence Livermore National Lab
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- National Academy of Sciences
- US Postal Inspection Service
- US Secret Service
- Many others...



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- Many others...