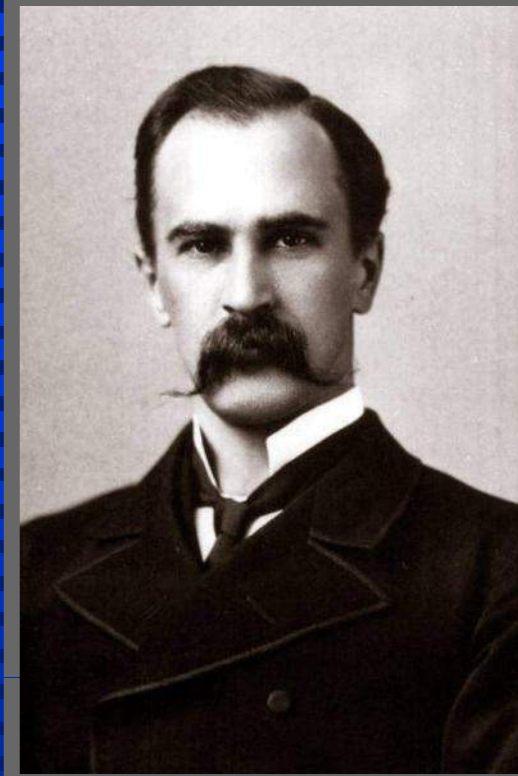


# Action Plan for Public Policies, Health Systems and Communication: Global Perspectives, Global Impacts

Frederick A. Murphy

Photo by Tim Murphy, 1989

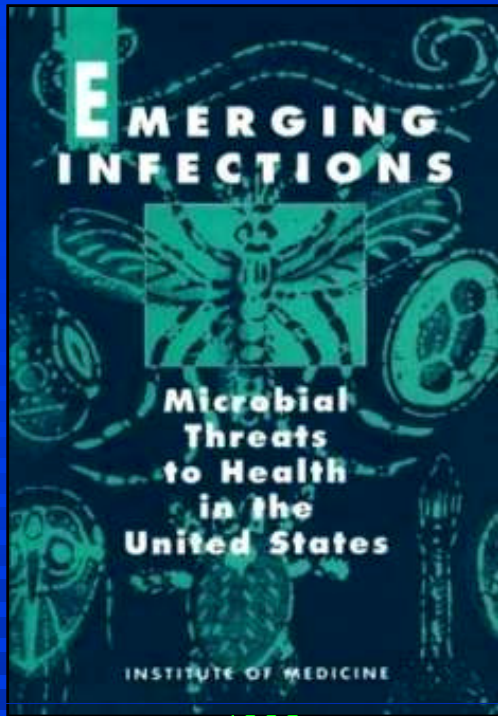




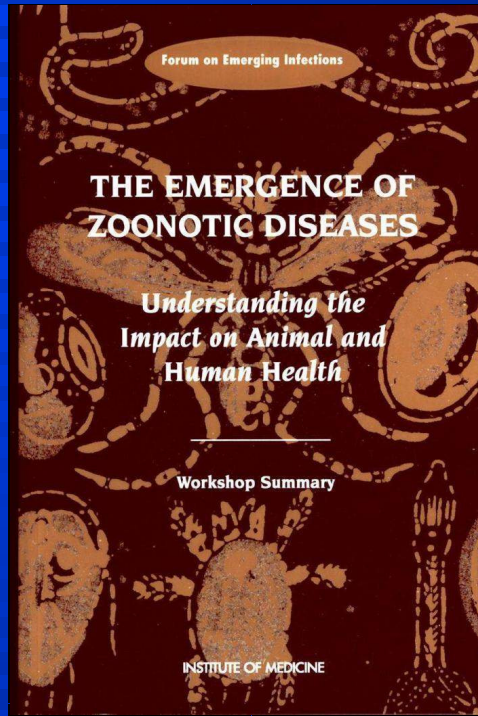
Sir William Osler (1849-1919)

***"One Medicine"***  
the term coined by Osler to  
encompass the relationship  
between human and  
veterinary medicine

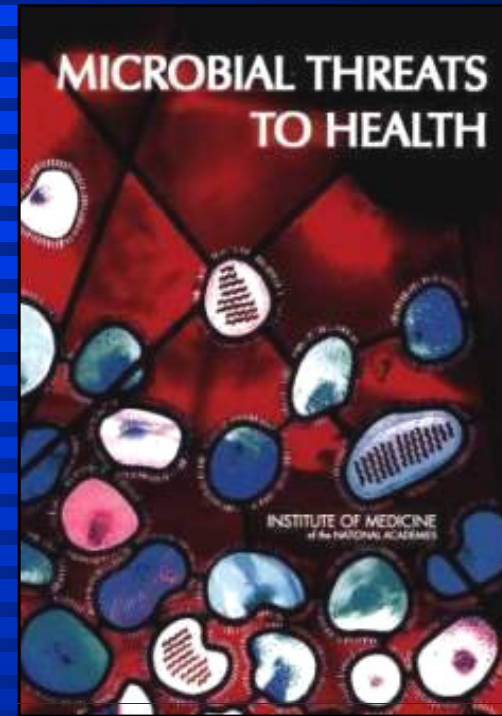




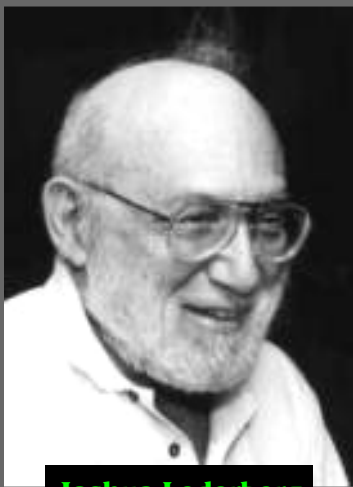
1992



2000



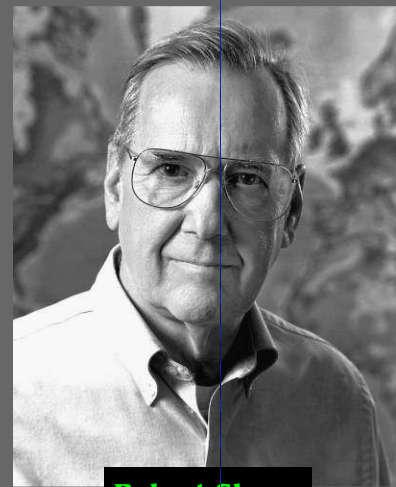
2003



Joshua Lederberg



Stephen Morse



Robert Shope

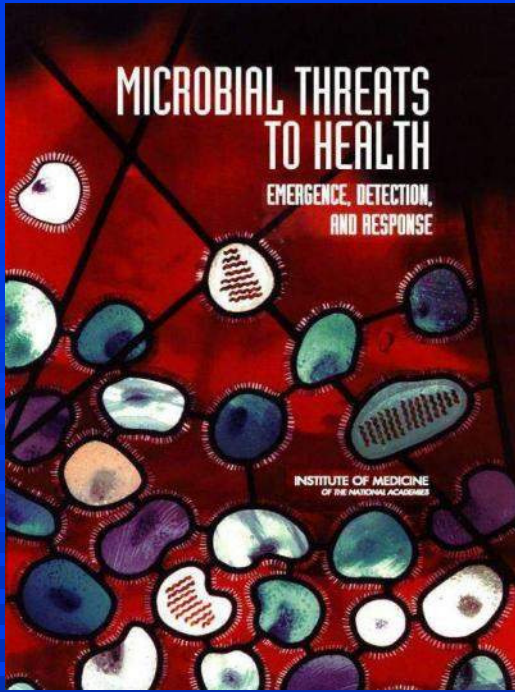


Margaret Hamburg



Mark Smolinski

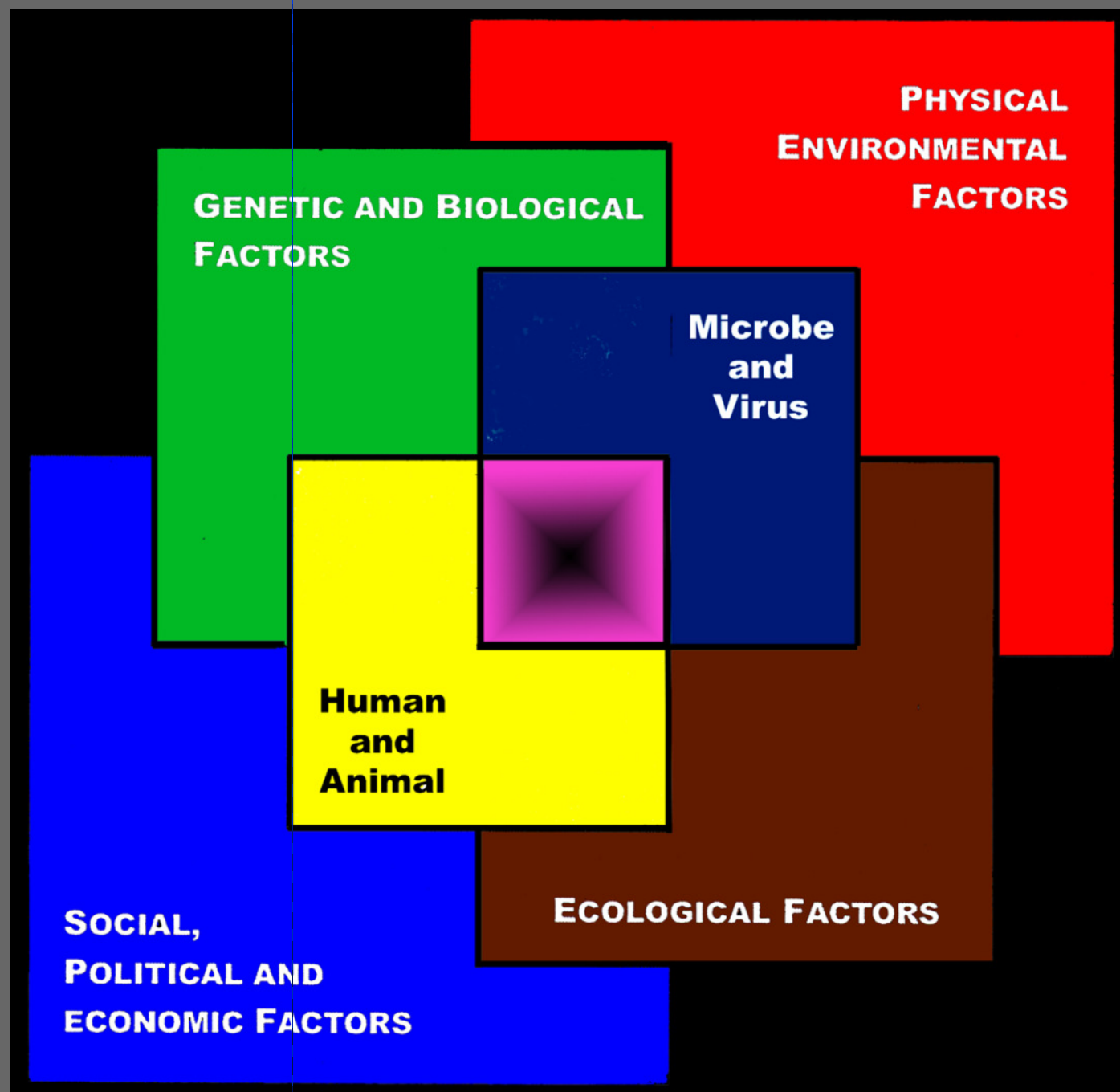
1992> J Lederberg, S Morse, R Shope, S Oaks, M Hamburg, M Smolinski, others development of the concept of *New, Emerging and Re-emerging Infectious Diseases*, the basis for rebuilding infectious disease research



## The Convergence Model

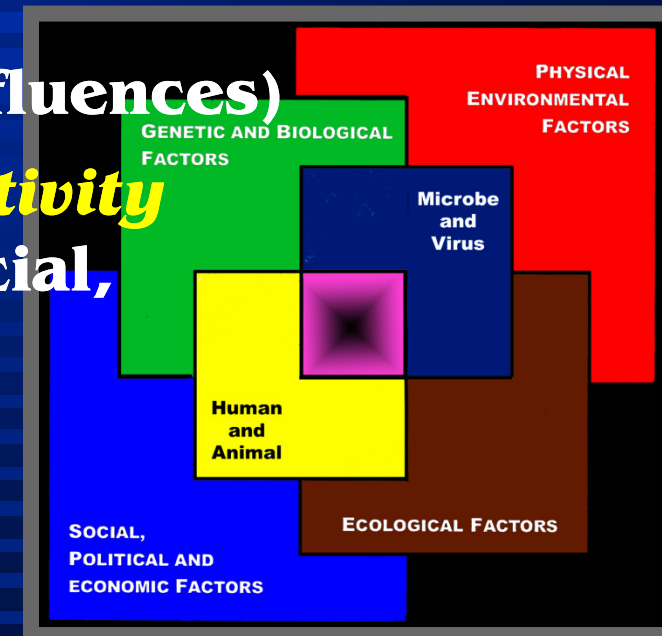
At the center is a box representing the convergence of factors leading to the emergence of an infectious disease. The black center represents unknown factors, "the black box."

From IOM Study:  
Microbial Threats to Health,  
Emergence, Detection and  
Response  
2003



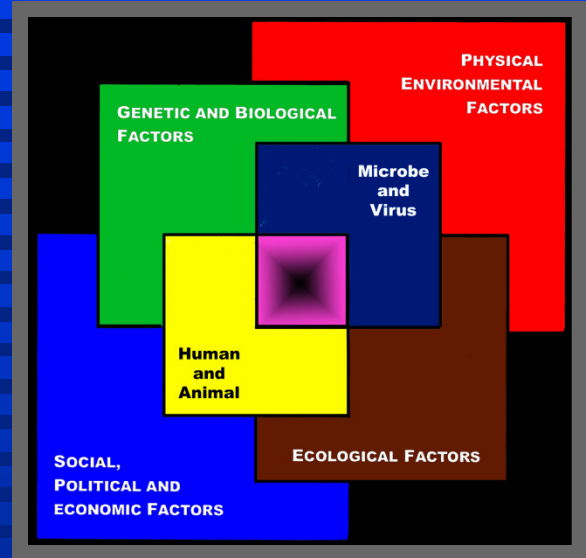
# The Nature of the Threat of New, Emerging & Re-emerging Zoonoses and Bioterrorism

- **Microbial / viral determinants**  
(mutation, natural selection, evolution)
- **Determinants pertaining to the host**  
(natural resistance, innate & acquired immunity)
- **Natural determinants**  
(ecologic, environmental, zoonotic influences)
- **Determinants pertaining to human activity**  
(personal behavior, societal, commercial, and iatrogenic factors)
- **Accidental or malicious release**



# Ecologic Factors Favoring New, Emerging & Re-emerging Zoonotic Diseases

- *Zoonoses are complex, seemingly fragile, but actually entrenched*
- *Zoonoses must be dealt with at the interface between public health and veterinary public health/animal health*
- The research base involves the interface between: virology (biologic & molecular biologic), immunology, pathology, ecology, animal biology, wildlife biology, mammology, ornithology, entomology, meteorology, climatology, geography, sciences pertaining to societal and commercial risk factors, economics, government, biodefense, etc., and the medical sciences and veterinary sciences



# New, Emerging and Re-emerging Diseases, 2010



***“Knowing is not enough; we must apply.  
Willing is not enough; we must do.”***  
— Goethe



**Motto of the Institute of Medicine  
National Academy of Sciences**



# Rabies, Still A Global Problem

**Rabies causes 40,000-70,000 human deaths each year; most in Asia and Africa; 30-50% in children (WHO)**

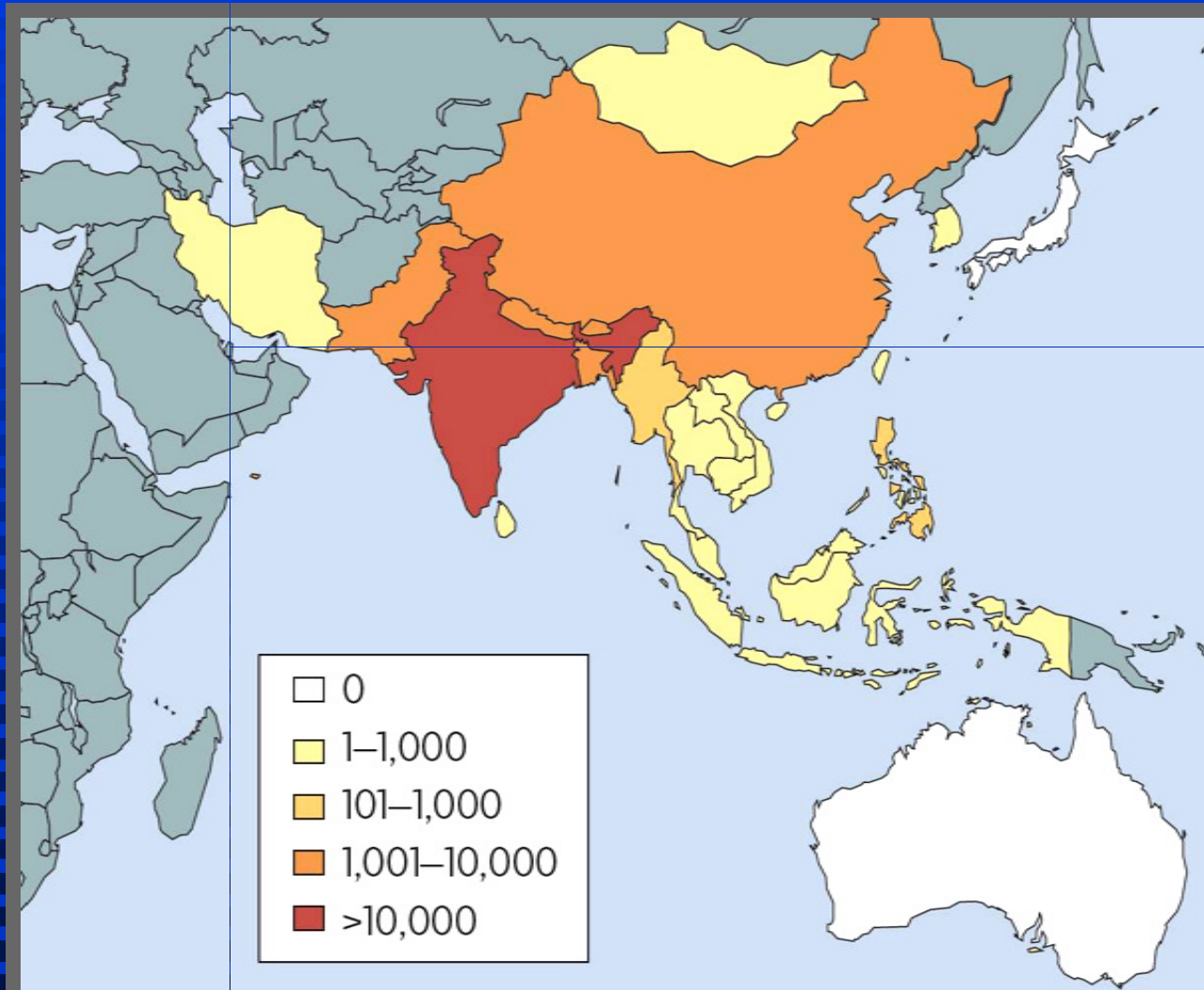
**10 million people receive post-exposure treatment each year**

**Most cases are still caused by the bite of a rabid dog**

**Most children who die from rabies have not received post-exposure treatment: vaccine and rabies immunoglobulin**

**There is a notorious lack of surveillance data. Underestimating the importance of rabies leads decision-makers to perceive rabies as a rare disease, resulting from the bite of an economically unimportant animal (the dog)**

**In many countries rabies falls in the crack between ministries of health and agriculture**



*A new understanding of the need for global health... global disease control..*



**Philippines**

**from Mary Elizabeth Miranda, DVM, Philippines**

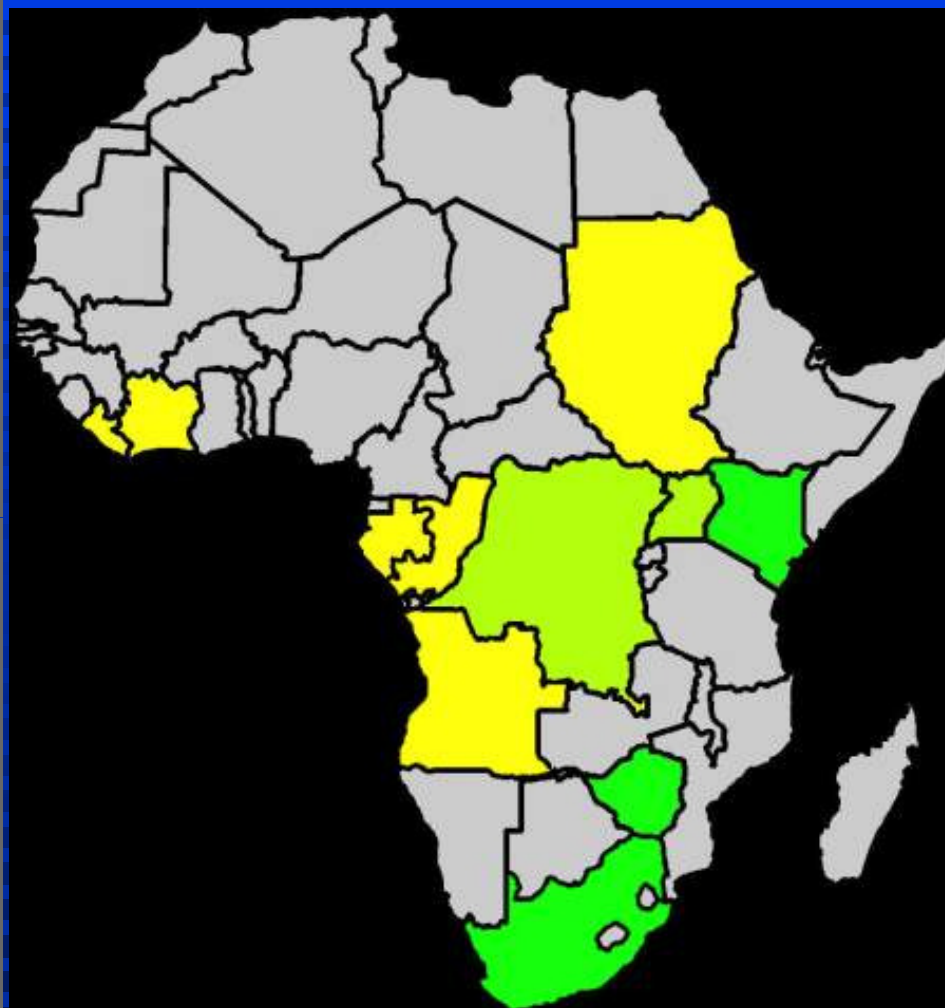


**Ebola...**

**A Global  
Perspective...**



<i>Year</i>	<i>Filovirus</i>	<i>Country</i>	<i>Cases</i>	<i>Death %</i>
1967	Marburg	Germany & Yugoslavia	32	21%
1975	Marburg	South Africa	3	33%
1976	Ebola-Zaire	Zaire	318	88%
1976	Ebola-Sudan	Sudan	284	53%
1976	Ebola-Sudan	England	1	0%
1977	Ebola-Zaire	Zaire	1	100%
1979	Ebola-Sudan	Sudan	34	65%
1980	Marburg	Kenya	2	50%
1987	Marburg	Kenya	1	100%
1989	Ebola-Reston	USA & Philippines	0	0%
1990	Ebola-Reston	USA & Philippines	0	0%
1992	Ebola-Reston	Italy & Philippines	0	0%
1994	Ebola-Zaire	Gabon	49	59%
1994	Ebola-Ivory Coast	Ivory Coast	1	0%
1995	Ebola-Zaire	Congo	315	81%
1996	Ebola-Zaire	Gabon	31	68%
1996	Ebola-Zaire	Gabon	60	75%
1996	Ebola-Zaire	South Africa	2	50%
1996	Ebola-Reston	USA	0	0%
1996	Ebola-Reston	Philippines	0	0%
1998	Marburg	Congo	128	64%
2000	Ebola-Sudan	Uganda	425	53%
2002	Ebola-Zaire	Gabon & Congo	122	79%
2003	Ebola-Zaire	Congo	>50	90%
2004	Ebola-Zaire	Sudan	17	41%
2005	Ebola-Zaire	Congo	12	75%
2005	Marburg	Angola	374	87%
2007	Marburg	Uganda	2	50%
2007	Ebola-Zaire	Congo	264	71%
2008	Ebola-Bundibugyo	Uganda	149	25%
2009	Ebola-Reston	Philippines	6	0%



# Viruses Isolated From Bats, Worldwide (from Charles H. Calisher) – >95 viruses

## Family *Rhabdoviridae*, genus *Lyssavirus*

Rabies virus

Lagos bat virus

Mokola virus

Duvenhage virus

Australian bat lyssavirus

European bat lyssavirus 1

European bat lyssavirus 2

Aravan virus

Khujand virus

Irkut virus

West Caucasian bat virus

## Family *Rhabdoviridae*, genus unassigned

Gossas virus

Kern Canyon virus

Mount Elgon bat virus

## Family *Paramyxoviridae*, genus *Henipavirus*

Nipah virus

Hendra virus

Menangle virus

## Family *Paramyxoviridae*, genus *Rubulavirus*

Tioman virus

## Family *Coronaviridae*

SARS coronavirus

Bat coronavirus

## Family *Togaviridae*, genus *Alphavirus*

Cabassou virus

chikungunya virus

eastern equine encephalitis virus

Highlands J virus

Sindbis virus

Venezuelan equine encephalitis virus

## Family *Flaviviridae*, genus *Flavivirus*

Bukalasa bat virus

Carey Island virus

Central European encephalitis virus

Dakar bat virus

Entebbe bat virus

Japanese encephalitis virus

Jugra virus

Kyasanur Forest disease virus

Montana Myotis leucoencephalitis virus

Penh bat virus

Reovirus

## Family

Catu virus

Guama virus

Nepuyo virus

Kaeng Khoi virus (genus unassigned)

## Family *Reoviridae*, genus *Orbivirus*

Ife virus

Japanaut virus

## Family *Arenaviridae*

Tacaribe virus

## Family *Herpesviridae*, genus unassigned

Agua Preta virus

## Unclassified

Issyk-kul virus

Keterah virus

Mapuera virus

Mojui dos Campos virus

Yogue virus

Bats: Important Reservoir Hosts of Emerging Viruses.  
CH Calisher, JE Childs, HE Field, KV Holmes, T Schountz  
Clinical Microbiology Reviews 19:531-545, 2006

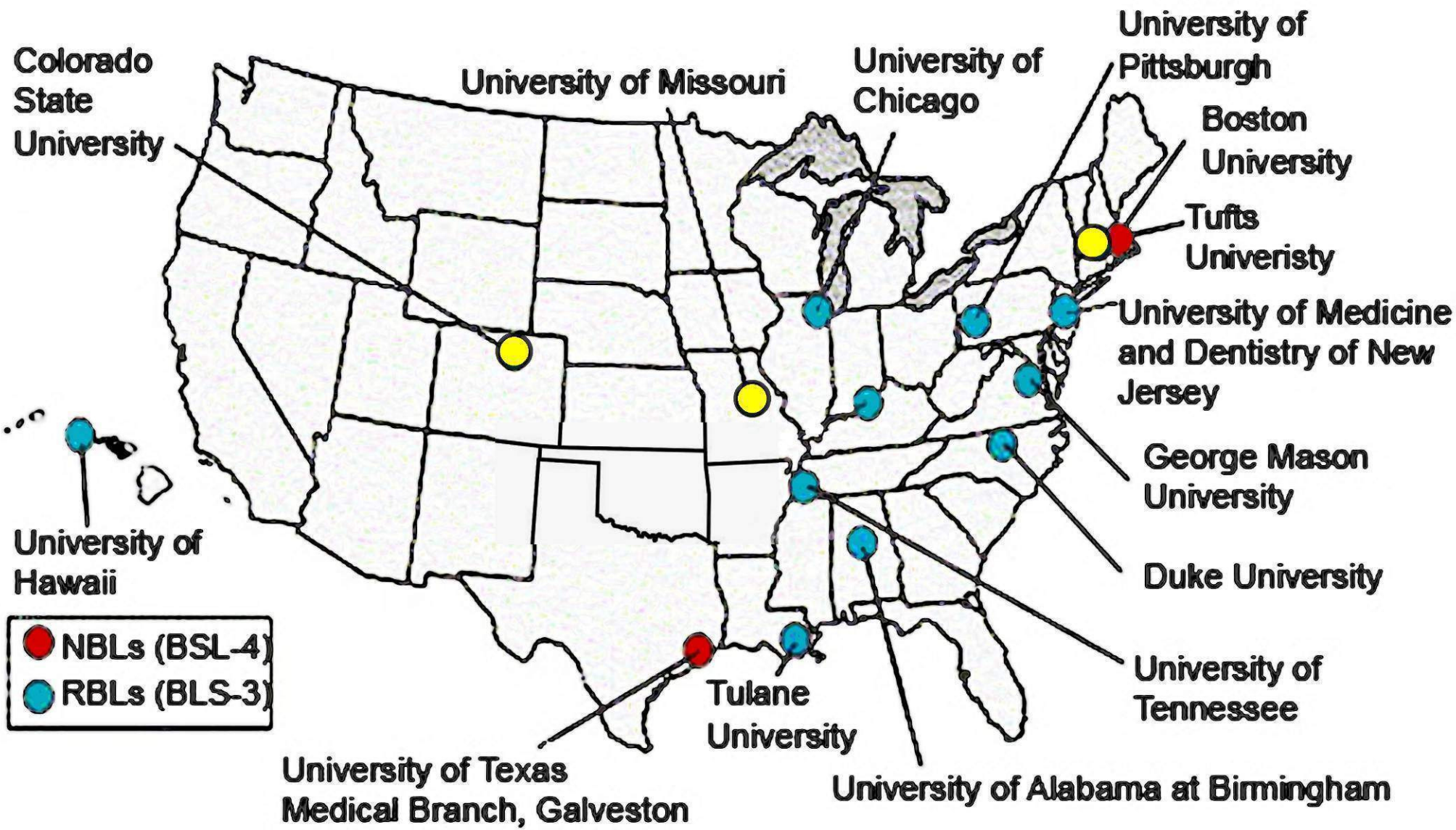
**Nearly all of the most  
dangerous pathogens  
(BSL4) are zoonotic**

**Brian Bird, DVM/PhD  
Then at School of Veterinary Medicine  
UC Davis (right)**

**David White, DVM/PhD  
Then at College of Veterinary Medicine  
Colorado State (left)**

**Maximum Containment Lab  
CDC, Atlanta, 2005**





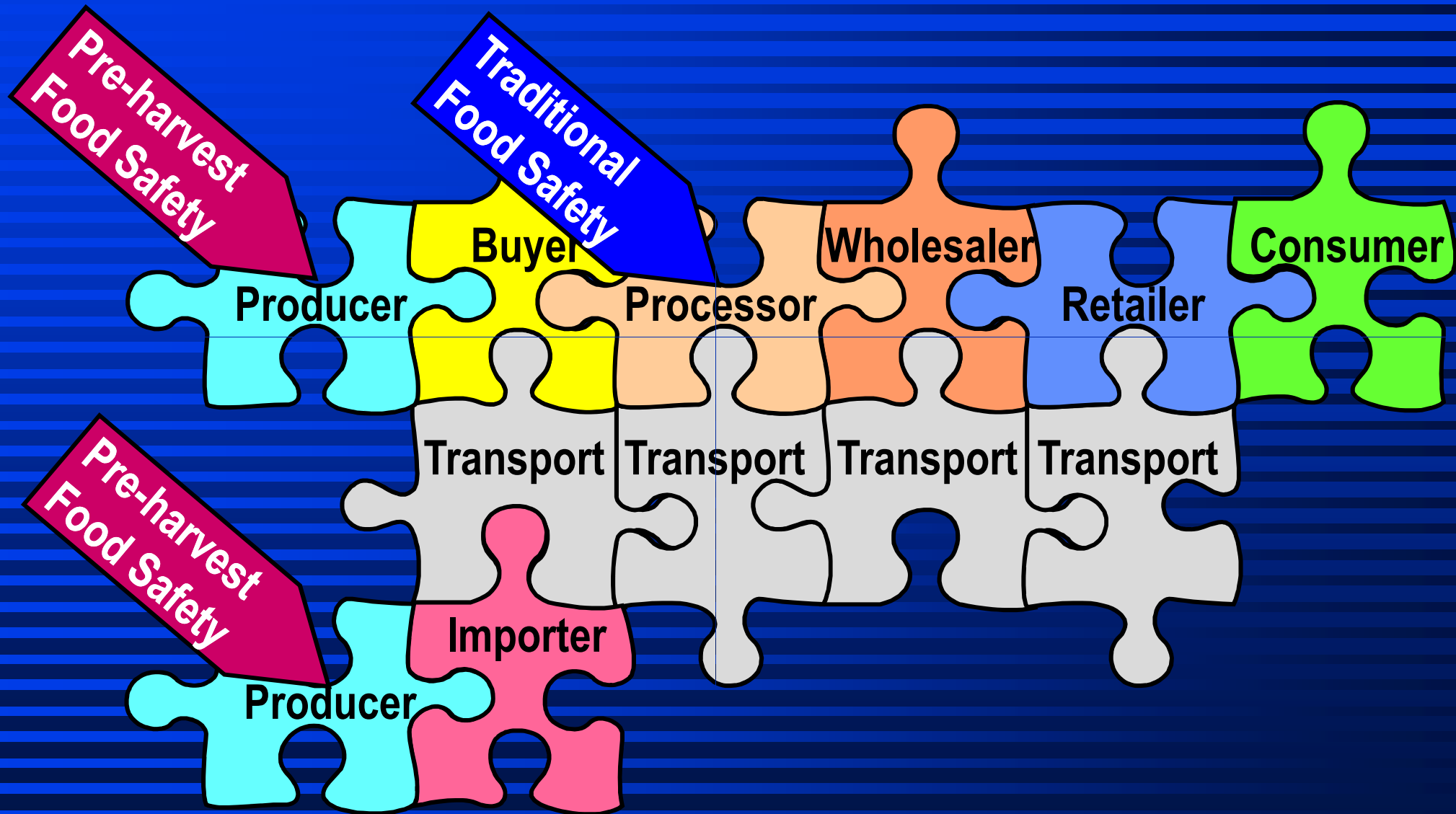
**● = Regional Biocontainment Labs at Schools of Veterinary Medicine (Colorado State University, Tufts University, University of Missouri)**

# Modern Animal Agriculture and the Emergence of Infectious Diseases

- **Bringing together of large numbers of animals at high density**
- **Asynchronous introduction of animals from diverse sources**
- **Care of animals by inadequately trained workers**
- **Elaborate housing systems with complex air/feed/waste systems**
- **Manipulation of natural biologic rhythms (artificial daylight, estrus synchronization, growth hormone, etc.)**
- **Global movement of food products, animals, semen, embryos, other animal products**
- **Major changes in food production, processing and distribution**
- **Rise of novel, trendy foods (e.g., ostrich, deer, elk, buffalo, etc.)**



# The Real Human Food Chain



**1986: BSE identified in cattle in England**

**1987: Announcement that large numbers of cattle are infected**

**1988: Orders to slaughter all BSE-infected cattle**

**1989: Southwood Committee Report:**

**“...it is most unlikely that BSE will have implications for human health...”**

**1990: 23 countries ban British beef as a public health measure**

**1990:**

**UK agriculture minister John Gummer attempts to allay public fears about the safety of beef by feeding his daughter, Cordelia, a hamburger**



**Public perception?**

## Mad cows and the minister

A realistic assessment of the risk to human health from bovine spongiform encephalopathy, rather than the hollow pronouncement that "beef is safe" would best counter public fears in Britain.

PUBLIC alarm, even hysteria, has been reawakened in Britain over the possible consequences for human health of the outbreak of bovine spongiform encephalopathy (BSE) in the cattle herd. Several local education authorities

certainly be strengthened.

Two difficulties arise. If transmission from cattle to people is possible, and has happened, the disease that will

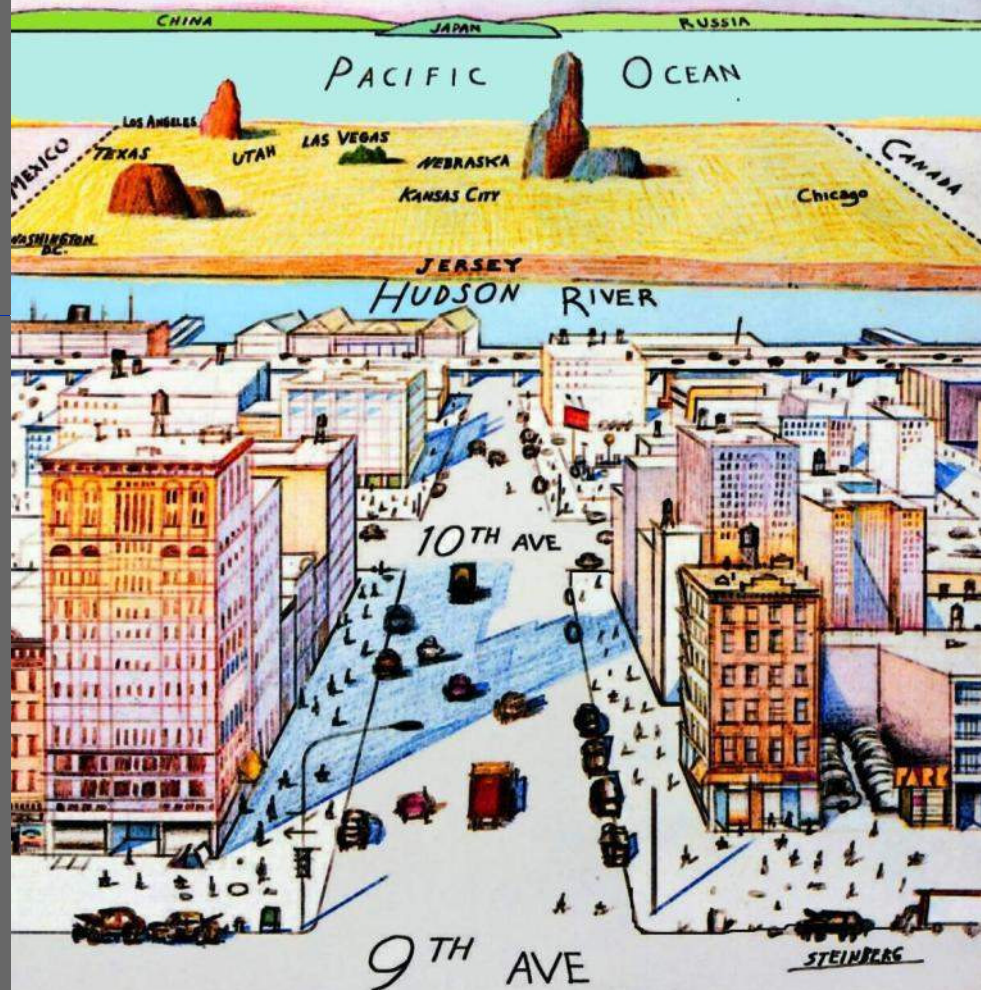
By 1990, as the BSE epidemic escalated, questions were raised across the UK, "...does BSE pose a risk to human health?" Government officials responded "...there is nothing to worry about..." This of course led the public to become more skeptical. The editors of **NATURE** reacted:

**"...Never say there is no danger {risk}. Instead, say that there is always a danger {risk}, and that the problem is to calculate what it is... Never say that the risk is negligible unless you are sure that your listeners share your own philosophy of life..."**

Mar. 29, 1976

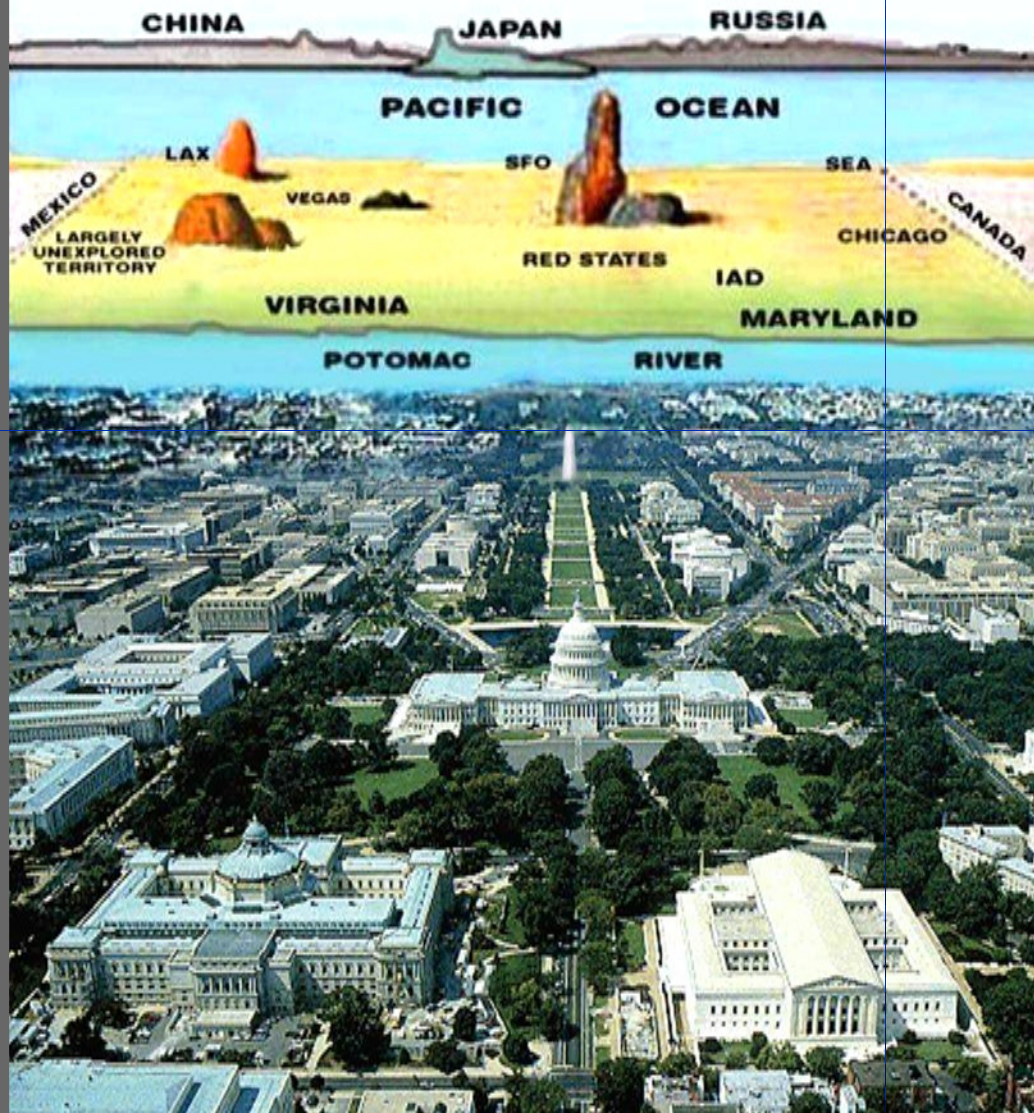
# THE NEW YORKER

Price 75 cents



**The Original...**  
**Saul Steinberg's New Yorker Cover**  
**"View of the World from Ninth Avenue"**  
**(1976)**

# THE NEW YORKER

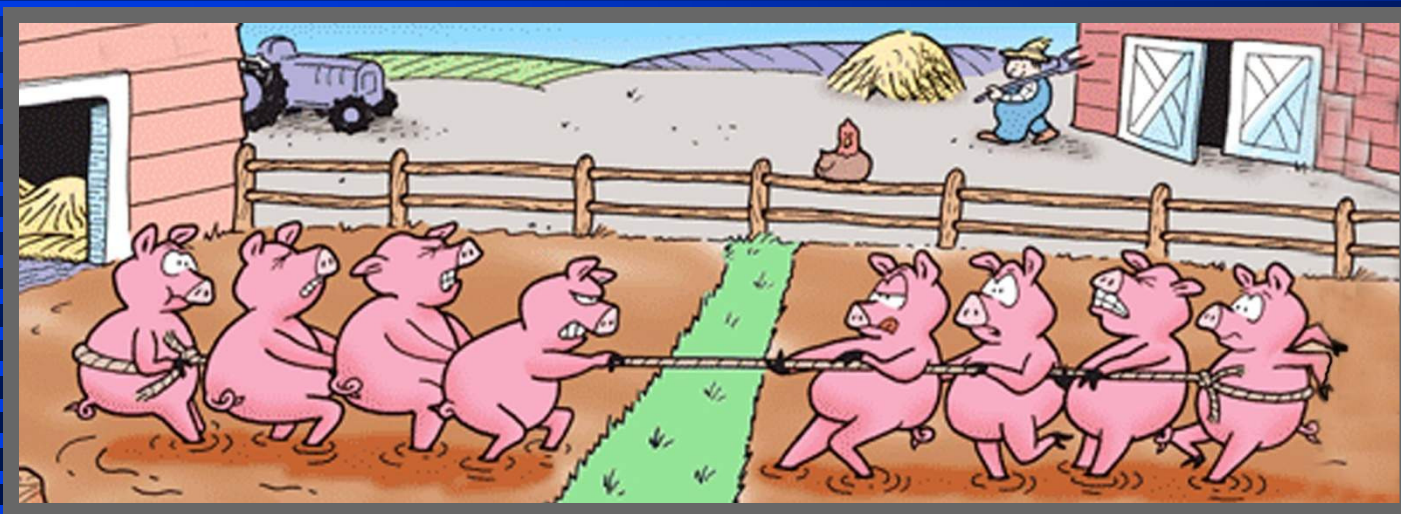


**A New Version of Saul Steinberg's  
New Yorker Cover, "View of the  
World from Ninth Avenue" (1976)**

***"View of the United States  
from Inside The Beltway"  
(2010)***

# Historic Turf and Turf Battles

- For particular zoonotic infectious agents, general oversight and control responsibility has largely been in the hands of people associated with different government and academic communities:
  - **Animal health and agriculture** (e.g., *Mycobacterium bovis*; *Brucella abortus*; traditional bacteria of concern in preharvest food safety).
  - **Public health and medicine** (e.g., rabies virus; arthropod-borne viruses, bacteria, and protozoa; rodent-borne viruses and bacteria; primate-borne viruses and bacteria).
  - **"In between" – new turf issues ?** (e.g., new influenza viruses; *Salmonella enteritidis*; *Listeria monocytogenes*, many protozoa and parasites, novel bacteria of concern in preharvest food safety).



# Economic Impact of an Avian Influenza Pandemic

## Asian Development Bank (2005):

*“If the disease remains primarily confined to poultry, the aggregate impact on the economies of the Asian region will be hardly perceptible...”*



# Economic Impact of an Avian Influenza Pandemic

## ● However, if there is a human pandemic...

- **U.S. (CDC, 1999 study): 100,000-200,000 deaths, >700,000 hospitalizations, 40M outpatient visits; 50M additional illnesses**
- **U.S. (CBO): cost \$100-200B / year (1.5% drop in GDP)**

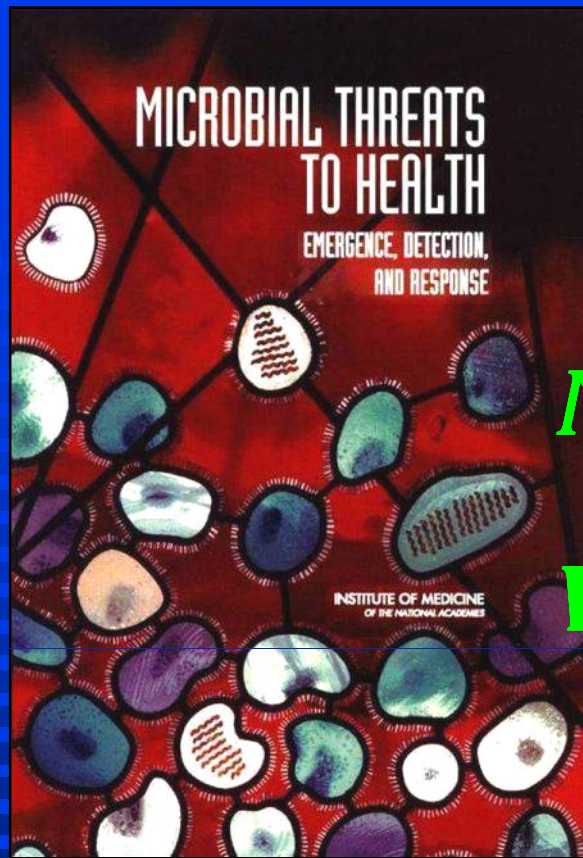
## ● If the pandemic is like the 1918 pandemic...

- **U.S. (CBO): 2M deaths (2.5% of cases); 90M illnesses**
- **U.S. (CBO): Cost ~\$500B (5% drop in GDP / year, more than in any postwar recession except that in 1982)**
- **Economic growth stops – 0.75% permanent workforce reduction**



# Economic Impact of an Avian Influenza Pandemic

- **However, if there is a human pandemic...**
  - **Worldwide (WHO): 2-7M deaths; 28M hospitalizations; 1.2B cases [Other estimates are much higher, exceeding 100M deaths]**
  - **Worldwide (ADB, 2005): cost \$950B / year**
  - **Worldwide (World Bank, 2005): cost >\$800B / year (>2% of GDP)**
  - **Severe economic shock: tourism, transportation, retail sales, hotels and restaurants, workplace absenteeism, disruption of production processes and food supply**

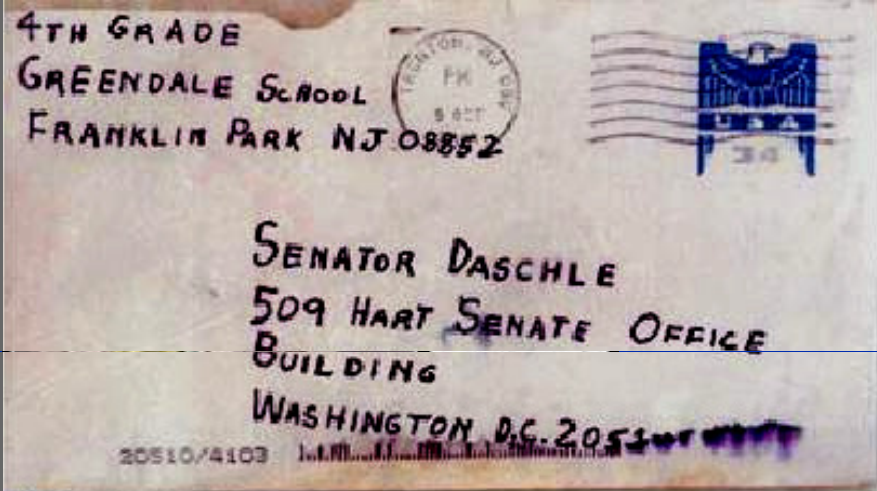
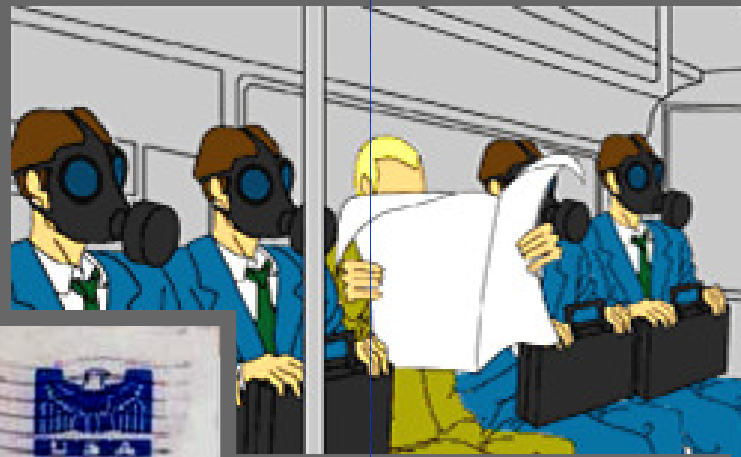


*New & Emerging Zoonoses*

*What's Next ?...*

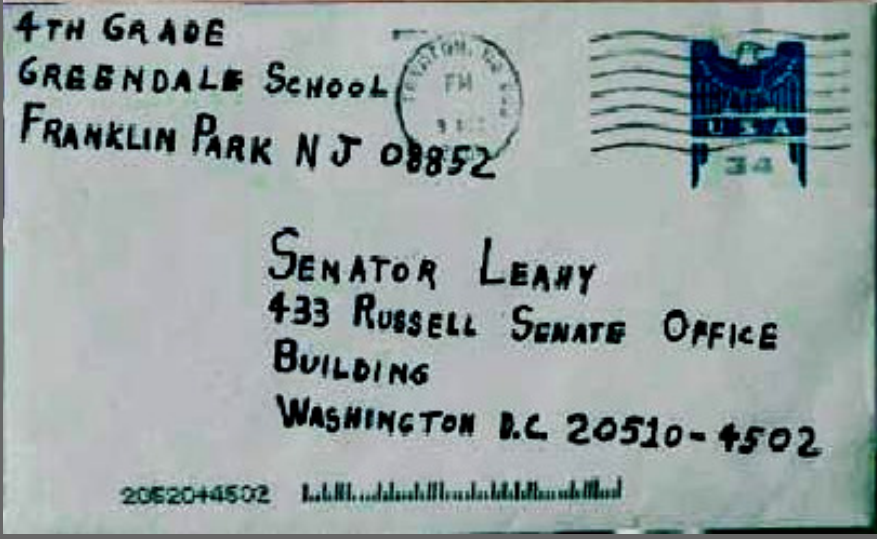


# ANTHRAX



### Anthrax Has Appeared

	<b>New York City</b>
1 letter	An NBC employee developed skin anthrax from a contaminated letter.
	2 illnesses
	2 locations
	<b>Trenton, N.J.</b>
2 letters sent	Letters were sent from a post office here to NBC and to the office of Senate Majority Leader Thomas A. Daschle.
	1 location
	<b>Washington</b>
1 letter	A letter delivered to Daschle's office tested positive for anthrax bacteria.
	1 location
	<b>Boca Raton, Fla.</b>
1 death	An employee at American Media died of inhalational anthrax and another became ill. Traces of anthrax were found in the building and at the local post office, although no packages were identified.
	<b>Reno, Nev.</b>
1 illness	Testing was being done to confirm the presence of anthrax bacteria on a letter received at a Microsoft office.
	1 location



# Agricultural bioterrorism ?



- **9,677 farms involved**
- **10 million animals killed (1-in-7 of all farm animals)**
- **Cost £6.3 billion (0.8% of GDP)**



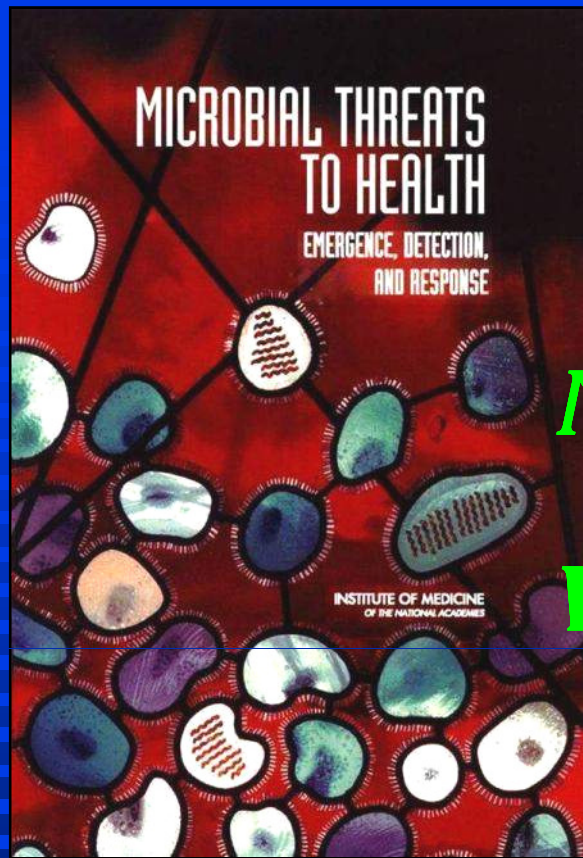
# COUNTERING AGRICULTURAL BIOTERRORISM

NATIONAL RESEARCH COUNCIL  
OF THE NATIONAL ACADEMIES

**Aurora Organic Dairy, Boulder County, Colorado**  
It is owned by Horizon Organic, which is owned  
the nation's largest dairy distributor, with \$10 billion in annual sales.

## Findings and Conclusions

- ❁ **The United States is vulnerable to bioterrorism directed against agriculture**
- ❁ **Intentional introduction of pathogens may differ substantially from unintentional introduction**
- ❁ **The nation has inadequate plans to deal with agricultural bioterrorism**
- ❁ **No publicly available, in-depth, interagency national plan has been formulated for defense against the intentional introduction of biological agents directed at agriculture**
- ❁ **There are important gaps in our knowledge of foreign-animal pathogens. These gaps reduce the reliability and timeliness of risk assessment and risk-management decisions**
- ❁ **Our ability to rapidly detect and identify most pathogens soon after introduction is inadequate. This allows them to spread, and makes it impossible to recover**
- ❁ **The adverse effects of bioterrorism agents on wildlife have not been considered**
- ❁ **The current inspection and exclusion program at the US borders is inadequate for countering the threat of agricultural bioterrorism**
- ❁ **A large-scale multi-focal attack on agriculture could not be responded to or controlled adequately or quickly and would overwhelm existing laboratory and field resources**
- ❁ **It is not feasible to be specifically prepared or have all the scientific tools for every contingency or threat to agriculture**
- ❁ **Although the nation's fundamental science, research, and education infrastructure (academic, industrial, and government) is in place and functioning, preparing the nation for agricultural bioterrorism requires special efforts and support of the infrastructure**
- ❁ **There is a need to enhance the basic understanding of threat agents so as to develop new and exploit emerging technologies for rapid detection, identification, prophylaxis, control**



*New & Emerging Zoonoses*

*What's Next ?...*



Forum on Microbial Threats

## LEARNING FROM SARS

Preparing for  
the Next  
Disease Outbreak

Workshop Summary

INSTITUTE OF MEDICINE  
of the NATIONAL ACADEMIES

## Extra Complexities When the Agent is Zoonotic

- *Investigation strategies are diverse, varying from disease to disease*
- *Investigation requires highly specialized knowledge and experience*
- *Investigation requires many areas of expertise: medicine, veterinary medicine, virology, pathology, ecology, animal biology, wildlife biology, entomology, etc.*
- *Few people have broad knowledge and experience in zoonotic disease investigation*
- *Investigation requires understanding of unique biosafety principles & practices, in the lab and in the field*
- *Investigation requires understanding of the concept of CONVERGENCE*





THE  
BLACK SWAN



The Impact of the  
HIGHLY IMPROBABLE

Nassim Nicholas Taleb

**Predicting the next emerging infectious disease**

# The New York Times

NY Times  
1995

Public Health

## Editorial

# Who Will Be the World's Epidemiologist?

The rare but terrifying Ebola virus has emerged from its hiding place in the African rain forests once again to kill scores of people in Zaire. The virus — one of a host of emerging viruses that have medical scientists worried — becomes an unbelievable nightmare on the infrequent occasions it invades the human body. It turns internal organs to mush, causes profuse bleeding from virtually every orifice, and typically kills 90 percent of those infected. There is no vaccine to prevent it, no drug to treat it, not even a clue as to what animal or insect serves as its normal reservoir until some luckless human comes into contact and is infected.

No wonder authors and film makers have seized upon Ebola or viruses like it as the ultimate horror. Were Ebola to mutate so as to become more highly transmissible, it could cause incredible death

and other body fluids. Primitive hospitals, where contaminated needles and instruments may be used on scores of patients, often amplify an initial outbreak.

The World Health Organization and the Federal Centers for Disease Control and Prevention have rushed experts to the scene to help find and isolate victims, making it likely that this outbreak can be contained as were earlier ones. But it is not hard to imagine an outbreak that could threaten the globe. A modest genetic change might enable Ebola to spread rapidly through the air, and infected travelers could spread the virus widely before anyone realized they were sick. Alternatively, a wholly different lethal virus that was readily transmissible could emerge.

A grateful public once thought that vaccine

Education, Advanced Training, Career Development



 **UTMB**

**The University of Texas Medical Branch**