

VIRAL WARFARE: THE SECURITY IMPLICATIONS OF BIOLOGICAL AND CYBER WEAPONS

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OUTLINE

- **Cyber Analogies**
- **Strategic Similarities Between Biological and Cyber Warfare**
- **Implications for International Security**
- **A Modest Proposal**

EMERGENCE OF CYBER WARFARE

- 2007: Distributed Denial of Service (DDoS) attacks against websites in Estonia
- 2008: DDoS attacks against websites in Georgia during military invasion by Russia
- 2009: DDoS attacks against websites in Israel, United States and South Korea
- 2009-2010: Stuxnet computer worm targets Iranian uranium enrichment program
- 2012: Wiper virus erases hard drives at Iran's Ministry of Oil; Shamoon virus destroys data on 30,000 computers at Saudi Aramco
- 2012-2013: Operation Ababil targets the websites of major U.S. financial institutions with DDoS attacks
- 2013: DarkSeoul Gang wipes hard drives of South Korean media broadcasters and financial firms

CYBER WARFARE ANALOGIES

“If we think of cyber as we did of aviation a little more than 100 years ago, we are just now on the beach at Kitty Hawk.”

- Gen. (ret.) James James Stavridis, Dean, Fletcher School of Law and Government

“We should start to consider that regret factors associated with a cyber-attack could, in fact, be in the magnitude of a weapon of mass destruction.”

- Gen. James Cartwright, former vice chairman of the Joint Chiefs of Staff

“This mass vulnerability means we have entered a new age of threat, defense, deterrence and attack equivalent in some ways to the atomic age. Cyber attacks have the potential to damage our way of life as devastatingly as a nuclear weapon.”

- Adm. Mike McConnell, former Director of National Intelligence

CYBER-BIO ANALOGIES

“[C]yber weaponry might be more appropriately compared with biological and chemical arms.”

- Dr. Joseph S. Nye, Jr., Harvard Kennedy School

“Cyber warfare is in some ways analogous to the way people think about biological weapons.”

- Dr. John Arquilla, Naval Postgraduate School

“My concern now is to identify the common attributes of the [nonexplosive] weapons (cyber and biological), so we understand the task at hand and can limit the damage these weapons can do.”

- Secretary of the Navy Richard Danzig

STRATEGIC SIMILARITIES BETWEEN CYBER AND BIOLOGICAL WEAPONS

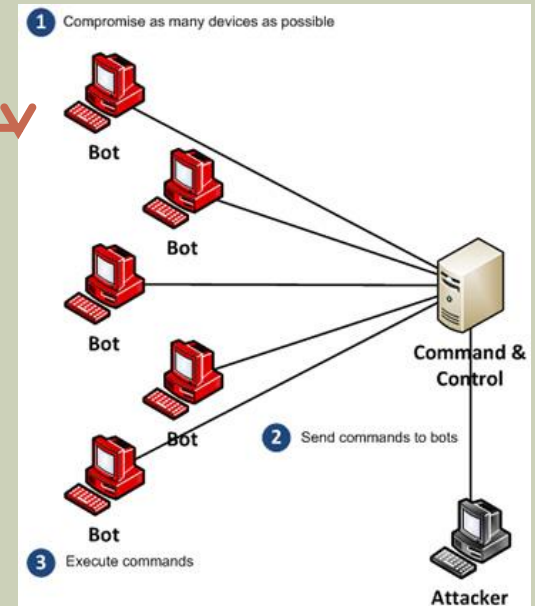
- Multi-use nature of the associated technologies
- Attacker has significant advantages over the defender
- Challenges of attribution following their use
- Use of covert programs to develop these weapons

MULTI-USE BIOTECHNOLOGIES



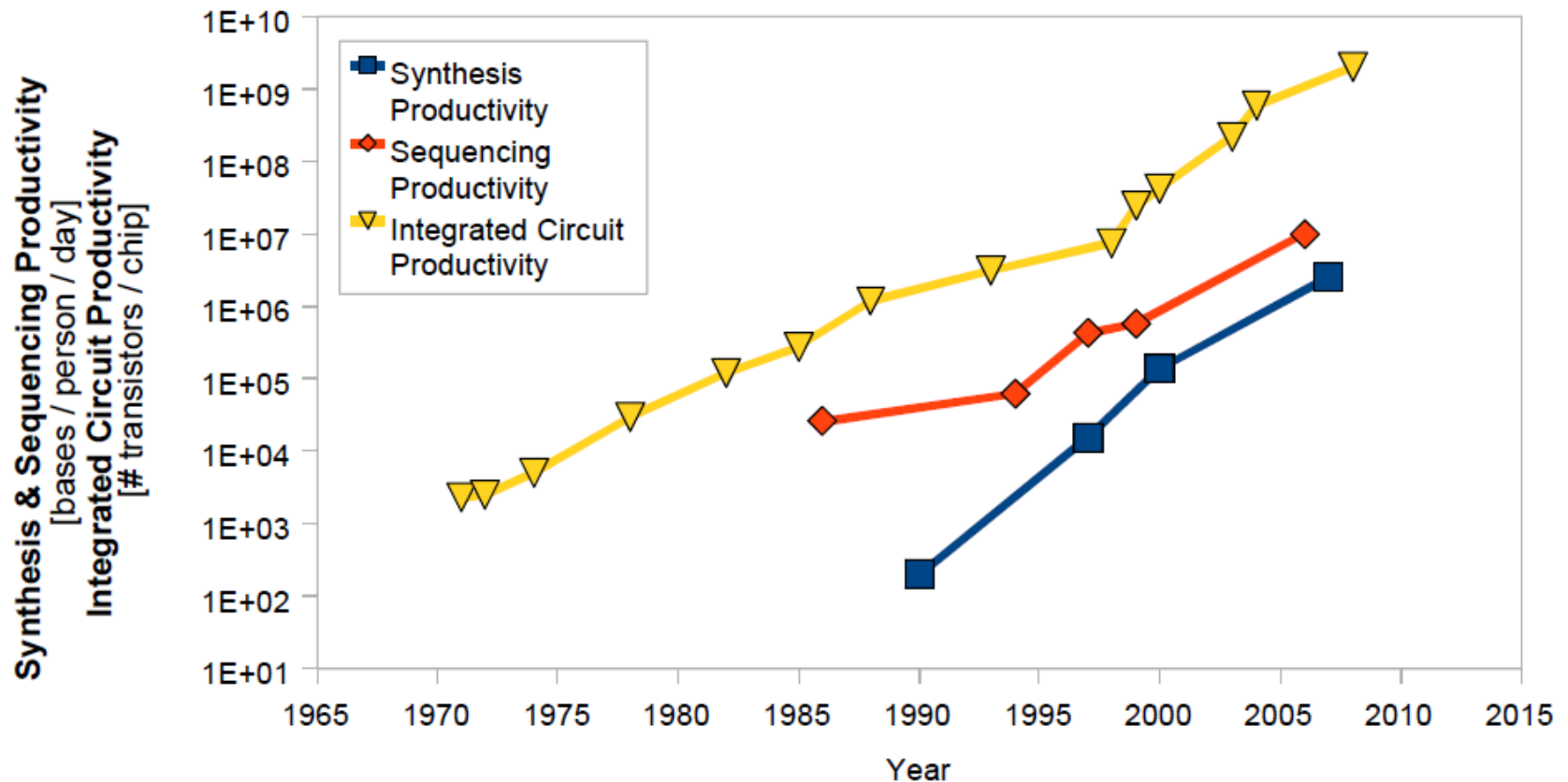
Figure 2. Two R-400A bombs in foreground photographed by UNSCOM inspectors at Al Tabaat Airfield near the Al Waid Airbase in late 1991 bear markings indicating they were to be filled with botulinum toxin. Other bombs appear to have markings consistent with binary chemical agent fill.

MULTI-USE INFORMATION TECHNOLOGIES



DYNAMIC THREAT ENVIRONMENT

Productivity in DNA Synthesis and Sequencing



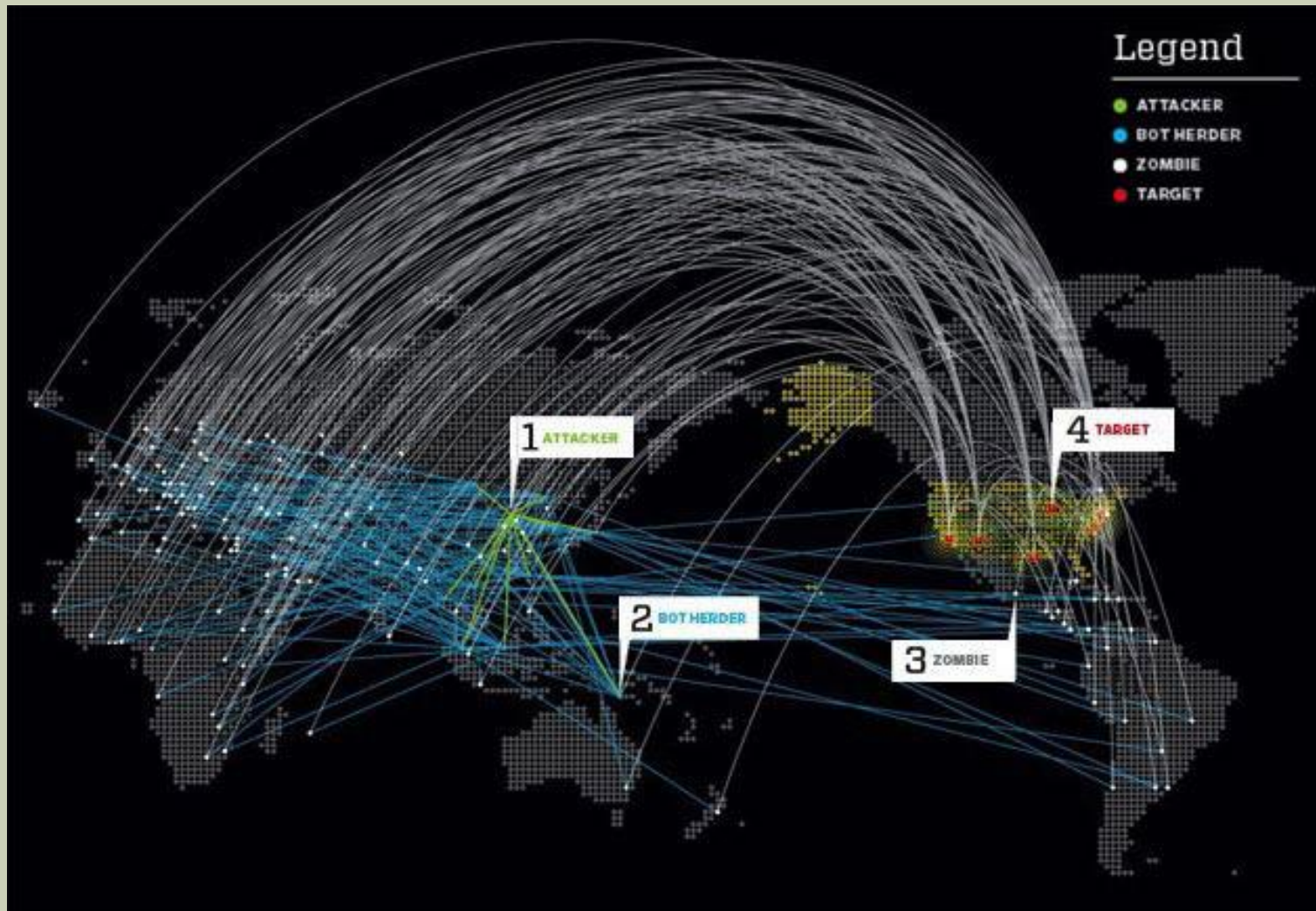
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BIOLOGICAL WARFARE AGENTS

Agent	Lethality (% if untreated)	Incubation Period (days)	Infectious Dose (organisms)	Vaccine/ Treatment
Bacteria				
Anthrax	>90	3-5	8,000-50,000	Yes/Yes
Plague	90	1-6	500-1500	No/Yes
Tularemia	35	2-10	10-50	No/Yes
Brucellosis	5	5-60	10-100	No/Yes
Virus				
Smallpox	30	7-17	10-100	Yes/No
Ebola	50-90	4-21	1-10	No/No
VEE	1	2-6	10-100	No/No
Toxin				
Botulinum Toxin	>90	1-5	.001 µg/kg	No/Yes

POWER PROJECTION IN CYBERSPACE

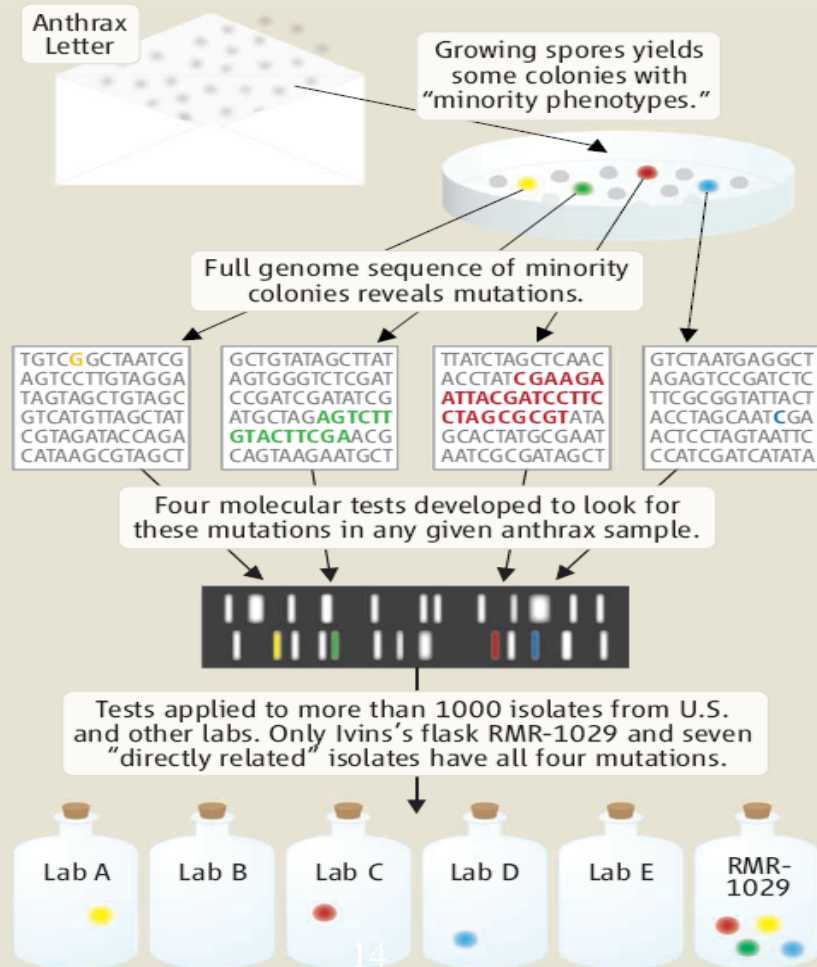


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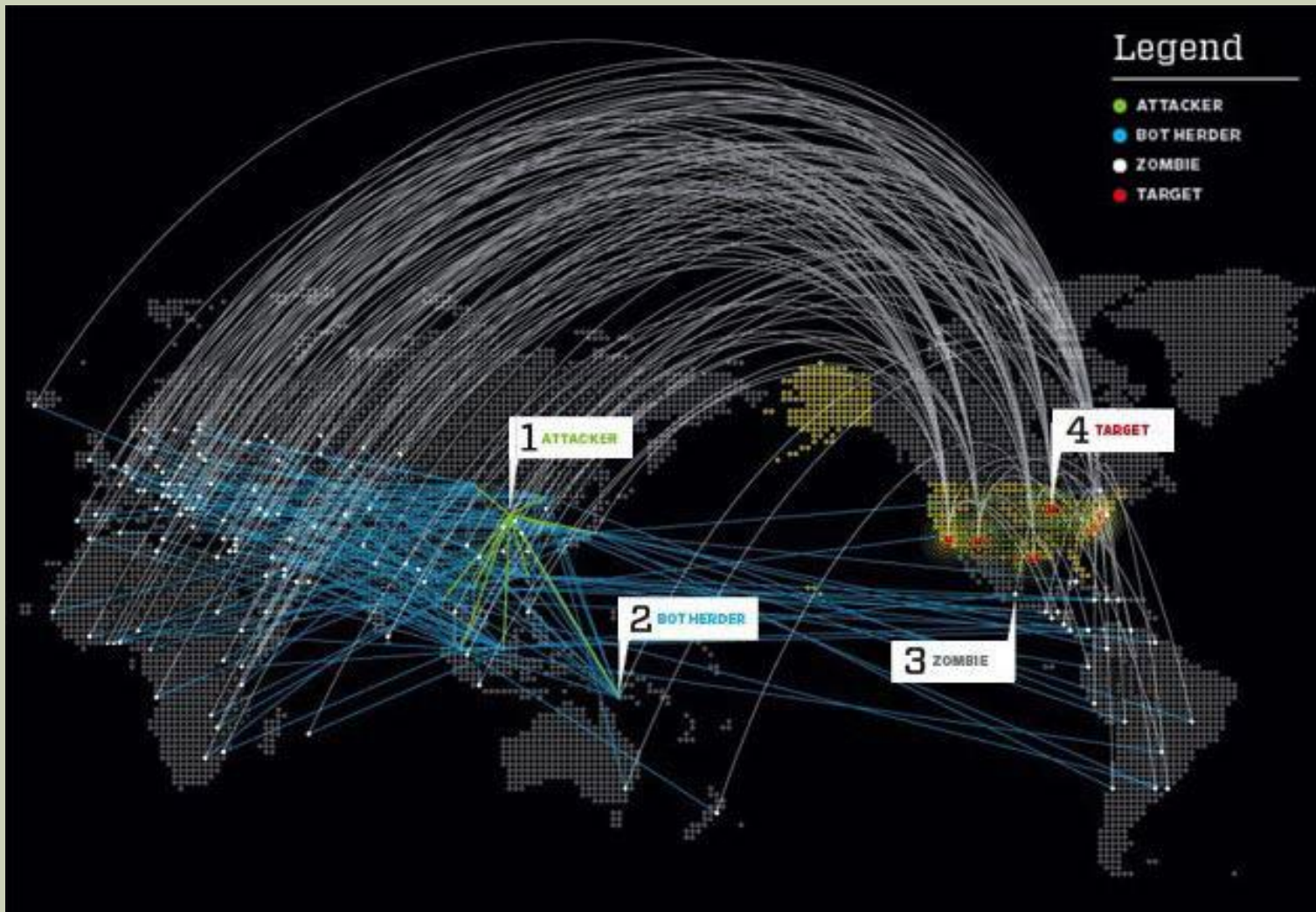
ATTRIBUTION FOR BIOLOGICAL ATTACKS

Anthrax: From Spores to Source



Source: Martin Enserink, "Full-Genome Sequencing Paved the Way From Spores to a Suspect," *Science* (August 15, 2008).

ATTRIBUTION IN CYBERSPACE



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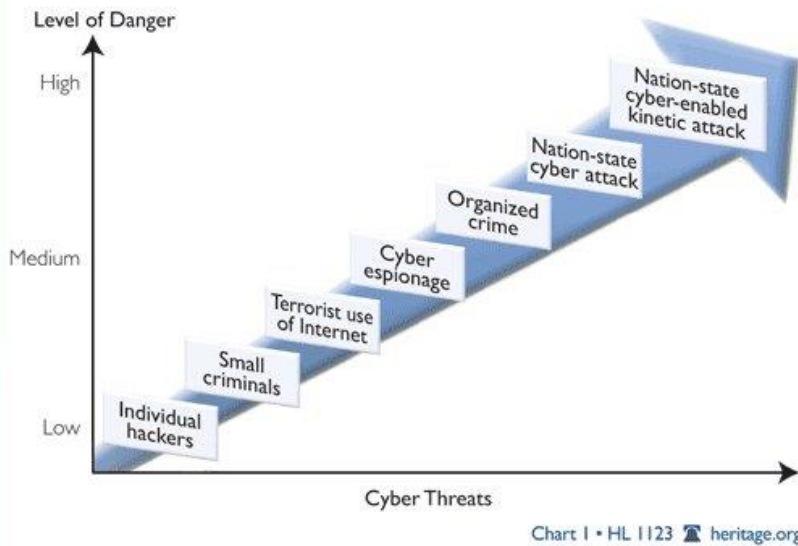
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IMPLICATIONS FOR INTERNATIONAL SECURITY

- Asymmetric Weapon
- Intense Security Dilemma
- First Strike, not Last Resort
- Importance of Norms
- Difficulty of Verification
- Flawed Intelligence

CYBER AND BIO RISK SPECTRUMS

Cyber Threat Spectrum



Source: Steven P. Bucci, “The Confluence of Cyber Crime and Terrorism,” *Heritage Lecture* (2009).

Figure 2. Taxonomy of Biological Threats

At-Risk Group	Source of Threat		
	State	Nonstate Actors	Nature
State	<u>Cell 1</u> Biological warfare (e.g., former Soviet and Iraqi biological weapons program)	<u>Cell 3a</u> Biological terrorism (e.g., Aum Shinrikyo, al-Qaida, and 2001 anthrax letter attacks)	<u>Cell 5</u> Pandemics (e.g., HIV/AIDS and pandemic influenza)
		<u>Cell 3b</u> Dual-use research (e.g., genetic engineering and synthetic biology)	
Individual, Community, or Society	<u>Cell 2</u> Biological warfare (e.g., South Africa's apartheid-era biological weapons program)	<u>Cell 4a</u> Biocrimes (e.g., puffer fish toxin case)	<u>Cell 6</u> Endemic and epidemic diseases (e.g., SARS, cholera, and West Nile virus)
		<u>Cell 4b</u> Laboratory accidents (e.g., Sverdlovsk and Pirbright)	

Source: Gregory Koblenz, “Biosecurity Reconsidered: Calibrating Threats and Responses,” *International Security* (Spring 2010).

SECURITY DILEMMA

	Offense Has Advantage	Defense Has Advantage
Offense-Defense Not Distinguishable	1. Intense Dilemma	2. Dilemma But Manageable
Offense-Defense Distinguishable	3. No Dilemma But Still Risk	4. Best-Case

ARE CYBER AND BIOLOGICAL WEAPONS THE “POOR MAN’S ATOMIC BOMB”?



THE IMPORTANCE OF NORMS

“There is no technical solution to the problem of biological weapons. It needs an ethical, human, and moral solution if it's going to happen at all. Don't ask me what the odds are for an ethical solution, but there is no other solution.”

**---Joshua Lederberg, Nobel Prize for
Medicine (1958)**

EFFORTS TO DEVELOP INTERNATIONAL NORMS FOR CYBER WARFARE

