The Combating Terrorism Center at
West Point

Bioterrorism Symposium

The technical enablers and challenges of biological terrorism

November 30, 2005

Chairman
Dr. David Franz

Speakers
Dr. Roger Brent
Dr. Stephen Johnston
Mr. Bill Patrick

Background and Format

Terrorists show a unique capacity to creatively use technology to achieve nefarious ends. The proliferation of chemical and microbiological expertise, coupled with the prevalence of modern terrorism, suggests that biological terrorism is a growing threat. More dangerous than chemical weapons and easier to acquire than nuclear devices, biological weapons are tempting terrorist weapons. Unfortunately, even after the anthrax attacks, the study of biological terrorism is still nascent.

The purpose of this workshop was to capitalize on the expertise of preeminent scientists and practitioners to educate USMA faculty and cadets, and explore methodologies for translating their knowledge into curriculum that can be implemented in USMA classrooms and beyond. The workshop was designed to advance the overall debate about bioterrorism at USMA, and in particular spark a discussion about how to adjust West Point curriculum so as to better prepare cadets for an uncertain world in which bioterrorism is a real possibility. Our next generation of military leaders should have the capacity to engage the policy and technical issues that the nexus of scientific expertise and extremism pose to the United States and the world.

The workshop was split into two sessions: one on *enabling* technologies, one on technical *barriers* to bioterrorism. Speakers gave brief statements that were followed by discussions with the audience. The audience included participants from the Social Sciences, Chemistry/Life Sciences, Math, Electrical Engineering/Computer Sciences, Law, and Geography/Environmental Engineering Departments. They were joined by representatives from the University of Connecticut and the FDNY Fire Academy.

The CTC would like to thank all of the speakers, two of whom flew across the country for a one day symposium in West Point. Further, the symposium could not have been a success without the participation of our audience. In particular 2LT Tony Benedosso, COL Cindy Jebb, LTC (R) Fritz Lash, MAJ Fernando Maymi, MAJ Ian McCulloch, Dr. Fred Moxley and COL Tom Mundie contributed great things during the conference and provided critical direction in the writing of this report.

The CTC is also grateful to the Alfred P. Sloan Foundation and, in particular, Dr. Paula Olsiewski, without whom this program would be impossible.

If there are any questions, comments, or concerns about the CTC's bioterrorism program, please contact Brian Fishman at 845-938-3697 or brian.fishman@usma.edu.

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Summary of Findings

Key information:

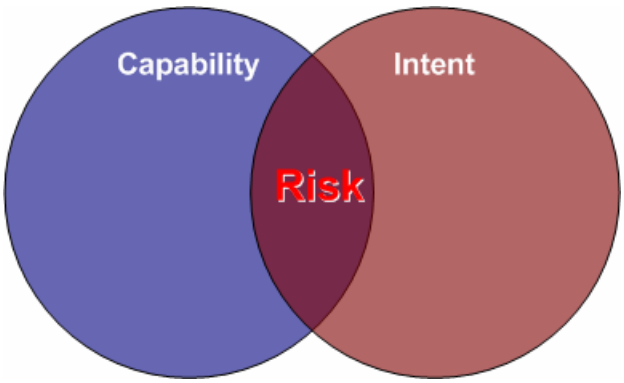
- Technology, particularly biotechnology, is accelerating at an exponential pace, reminiscent of Moore's Law in information technologies. For example, it is now possible, in hundreds of laboratories worldwide, to recreate the deadly 1918 influenza virus.

- Biotechnology will both drastically improve and proliferate widely long before today's USMA cadets become Colonels and General Officers.

- The threat of biology as a weapons system has the potential impact on the force and the nation equal to or greater than chemical or nuclear weapons. USMA cadets, at commissioning are conversant and even expert in mathematics, physics and chemistry, but are little better prepared in biology than they were when they left high school.

- Effectively employing a biological weapon for a mass casualty attack requires a large skill set that includes: biology, chemistry, and meteorology. Compiling the appropriate skill set is not simple.

- A venn diagram is a useful tool for conceptualizing the threat of bioterrorism: One circle represents laboratories and individuals with the capability of creating catastrophic agents and the second the number of terrorists with ill intentions. The danger lies at the intersection of these two diagrams. As technical barriers to biological weapons fall, the capability circle will grow, creating a larger area of risk even if there is a reduction of people with malicious intent.



- Proliferation may occur among today's terrorist threat groups: for example, the Koran has traditionally been interpreted to discourage the study and application of biology. This philosophy is changing. Recent statements by radical ideologues support and promote the use of "weapons of mass destruction" to kill thousands, including women and children.

- Current U.S. biological defense plans are designed to stockpile medicines to respond to a predictable set of attack scenarios. This approach is limited if a terrorist group develops an innovative attack plan.

- The typical career path of the military officer does not allow attainment of significant national or international acclaim in the biological sciences, but these leaders should be conversant enough with the biotechnologies and the biothreat to ask the right questions and identify the best solution sets for the force.

- Democracies of the world may have a window in time during which to use technological advantage to create defenses to stay ahead of the threat.

Recommendations

- The USMA should adopt an interdisciplinary approach to teaching key principles of combating the bio (WMD) threat. This could be done in several ways:
    - Developing a set of modular curriculum tools that can integrate questions of bioterrorism into traditional classroom settings. For example, creating bioterrorism models for analysis in a statistics class. (This report contains a more detailed discussion of this option.)
    - Creating a 'Biology for Leaders' course as part of a mandatory course curriculum. The course would obviously include the principles of biological---and possibly chemical and nuclear/radiological terrorism--- described above, but also other biological fundamentals such as a rudimentary understanding of the human immune system, a review of current options for active and passive defense and deterrence, etc.
- United States biodefense programs should be designed to quickly detect a biological attack, flexibly develop and distribute vaccines and antibiotics, and deter repeat offenders or copycats.
- Developing mechanisms to enable policymakers to quickly understand cutting edge scientific achievements is imperative for the biological weapons threat to be ameliorated in the long-run.
- The Combating Terrorism Center should present the workshop findings to national agencies as appropriate, and seek opportunities to collaborate nationally and internationally to increase recognition of this key policy problem and bring a better understanding and recognition to the faculty and cadets of the Academy.

Principles of Biological Terrorism Defense for Leaders

1. The power, complexity and trajectory of innovation within the biotechnology revolution.

2. The concepts of contagion and replication.

3. The variability of biology and the comparative degrees of vulnerability with various agents.

4. The complexity and massive destructive potential of the biological threat.

5. An understanding of the opportunities and shortcomings of various delivery mechanisms.

6. The social and political impact of a terrorist attack employing biological weapons.

7. An introduction to the historical use of biological materials as a weapon and discussion of the concept of 'reload.'

8. An understanding of how terrorists choose weapons and targets.

A uniformed army, or DoD, career is largely incompatible with the development of biologists on the cutting edge of research. The intensity and career focus required of the 'hard' biological disciplines does not leave space for the rigors and diversity of a typical military scientist's career. A soldier-scientist must typically, at least at the 0-5 or 0-6 level, give up leadership opportunities and even consciously forgo opportunities to remain competitive for flag rank to make the greatest positive impact as a scientist in uniform.

Nevertheless, USMA cadets should be aware of, willing to listen to, and intelligently question and critique the thoughts of our nation's best scientists. Upon commissioning, cadets, while perhaps not prepared to produce cutting edge biological research, should be capable of intelligently consuming such work.

Biographies

Roger Brent

Director, Molecular Sciences Institute

Roger was born in Spartanburg, South Carolina in 1955. He received a BA in Computer Science and Mathematics from the University of Southern Mississippi in 1973, where he did some work attempting to apply AI techniques to protein folding. He went on to get a Ph.D. in Biochemistry and Molecular Biology from Harvard University in 1982 for studies with Mark Ptashne.

In 1985, Roger became a Professor at Massachusetts General Hospital and Harvard Medical School Department of Genetics. He and his coworkers used yeast transcription that depended on chimeric DNA bound proteins as a genetic probe for protein function in higher organisms. This work led to the development of working two-hybrid methods (1988-1993), to the ability to scale them up via interaction mating (1992-1994), and to the eventual development of protein interaction methods as a useful way to learn more about biological function. In parallel, Roger and his coworkers developed peptide aptamers as reverse "genetic" agents to study the function of proteins and allelic protein variants (1999-2001), and, more recently, as dominant forward "genetic" reagents to identify genes and pathway linkages in organisms, such as human cells, that are intractable to classical genetic analysis. (Perhaps as important as the actual technologies is the co-development of ideology (e.g. doctrine) for using them.) This work is described in about 80 research papers and reviews.

In parallel to his academic work, Roger is a longtime (since 1984) advisor to the biotech and pharmaceutical industries. He served on the SAB of American Home Products (Genetics Institute/Wyeth Ayerst Research), chairs scientific advisory boards for several smaller companies, and does significant ad hoc consulting work in genomics and computational biology. He is one of the founders (1987-2001) of Current Protocols, including Current Protocols in Molecular Biology, a "how to clone it" manual, which is updated every three months and has about 10,000 subscribing labs. He is founder and organizer (since 1994) of the "After the Genome" workshops. He is an inventor on 11 issued and several pending US Patents. Since the middle 1990s, he has exhorted and advised various bodies in the US and abroad on functional genomics and computational biology, including the National Institutes of Health, the Wellcome Trust, the National Science Foundation, Department of Energy, Defense Advanced Research Projects Agency, and other parts of the US Defense Department.

Roger joined the Molecular Sciences Institute in 1998 as Associate Director. He was named Director in 2000 and President and CEO in 2001. Brent joined the faculty of UCSF Department of Biopharmaceutical Sciences as an Adjunct Professor (2000) and was named a Senior Scholar of the Ellison Medical Foundation (2001).

Dr. David Franz

Combating Terrorism Center Senior Bioterrorism Fellow

David Franz is the Center's Senior Fellow for Bioterrorism. He is a retired Colonel in the U.S. Army, having served 23 of his 27 years on active duty in the U.S. Army Medical Research and Material Command. He has served as both deputy commander and commander of the U.S. Army medical Research Institute of Infectious Diseases and as Deputy Commander of the Medical Research and Materiel Command. He also served as veterinarian for the 10th Special Forces Group (Airborne).

In addition to his time on active-duty, Franz served as chief inspector for three U.N. Special Commission biological warfare inspection missions to Iraq and was a member of the first two U.S./U.K. teams that visited Russia to support the trilateral Joint Statement on Biological Weapons. He has served on numerous governmental advisory committees on bioterrorism. Currently, Dr. Franz is the director of the National Agricultural Biosecurity Center, located at Kansas State University and is the Senior Biological Scientist at the Midwest Research Institute. He is a resident graduate of the Army Command and General Staff College, a recipient of the Army Research and Development Achievement Award, the Order of Military Medical Merit and the Legion of Merit with oak leaf cluster. Dr. Franz holds a D.V.M. from Kansas State University and a Ph.D. in physiology from Baylor College of Medicine.

Stephen Johnston

Director, Center for Innovations in Medicine—Arizona State University Biodesign Institute

Stephen Albert Johnston, PhD, leads an interdisciplinary team that seeks advanced solutions to basic medical problems. Specific research includes drug targeting, vaccine technology, cancer treatment and presymptomatic diagnosis of cancers through identifying the biosignatures of disease. Dr. Johnston engages the most advanced technologies in biology and chemistry in the pursuit of use-based science. He believes an interdisciplinary teams of chemists, biologists and computer scientists with highly aspirational goals. This includes creating a system for early detection and universal treatment of all cancers. A second is to create a simple at-home instrument that would take an individual's biosignature every day. This "biosignature" would read out hundreds of your blood components and compare it to all previous readings. This would allow detection of illness before the onset of symptoms. If developed, this technology would transform medicine into a personal, presymptomatic mode.

Dr. Johnston's current emphasis is on immune manipulation, vaccines and biosignatures. Johnston also conducts basic research into how genes are regulated. Past inventions of his include the gene gun and gene vaccines.

Much of the research within the new Center for Innovations in Medicine will focus on developing treatments that target disease at the genetic level. Promising work in cancer research is coming from advances in molecular science because the ability to selectively target cancer cells promises more effective treatments without the devastating side effects of current treatments.

Dr. Johnston recently joined ASU from University of Texas Southwestern Medical Center (UTSW) where he was Professor of Internal Medicine and the Eugene Tragus Chair in Cardiology. He and three colleagues founded the Center for Biomedical Inventions at UTSW in 1998, Johnston served as Director of the center until his decision to join ASU.The center was among the first to bring a broad group of disciplines together to invent solutions to basic problems in medicine. Since its establishment in 1998 the Center for Medical Innovations in Dallas has generated over $1 million in grants, published over 200 publications in leading research journals, been granted 14 patents and formed two spinout companies.

William C. Patrick, III

President, BioThreats Assessment, Inc.

William C. Patrick, III has over 50 years of experience in the field of Biological Warfare, including seven years as Chief of the Product Development Division, Biological Warfare Laboratories before the U.S. offensive program was disestablished in 1972. Mr. Patrick has made numerous guest lecturing appearances at the National War College, Army War College, Air War College, MIT, CDC, and the National Academies of Sciences. He holds five U.S. patents pertaining to biological processes and equipment, and has authored 16 articles in the scientific literature as well as 98 major in-house Department of the Army publications.

Bill has performed contractual services for the Defense Intelligence Agency, CIA, FBI, Unites States Secret Service, USAMRIID and other institutions, in addition to briefing the highest levels of government, including the U.S. House and Senate Intelligence Committees, Secretaries of Army, Navy, and Department of Defense. He was a Team Leader of a United Nations UNSCOM inspection visit to Iraq where his analytical observations provided the nearest thing to "Smoking Gun Evidence" of Iraqi bioweapons intent. He has appeared on all of the major television networks as well as Canadian Broadcasting, the BBC, The History Channel, and The Discovery Channel. He has been awarded a CIA Meritorious Citation, and the Order of Military Medical Merit.

Mr. Patrick received his B.S. from University of South Carolina and his M.S. in Microbiology – Biochemistry from the University of Tennessee.