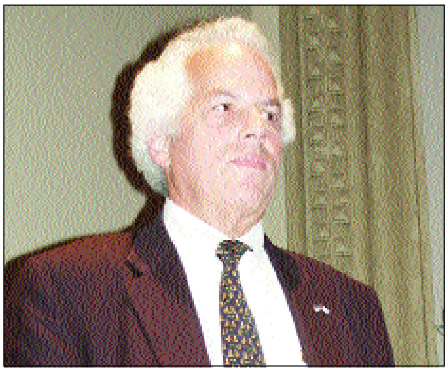
The Response
of Academic Medicine to the Threat of Bioterrorism



Professor Stanley PRUSINER:
Professor of Biochemistry, UCSF. Recipient,
Nobel Prize in Physiology/Medicine, 1997

Professor Prusiner explored the role of the academic community working as a partner of the government and addressed various aspects of this issue.

Dangers of Scientific Development

Prusiner, in defining the term "biological warfare" as "the use of microbes and/or toxins as weapons" underscored the dilemma posed by scientific advances in the field, which are largely a result of academic research. "Unfortunately," he said, "these advances are contributing to the constantly growing pool of potential weapons from which terrorists can choose. Scientific advances are creating a constantly enlarging pool of potential weapons, from which the terrorists can choose.Genetic engineering, for example, has made an entirely new (artificial) set of biological weaponsavailable to terrorists. Genetic engineering allows for entirely new, artificial biological weapons to be created". He went on to say that.

Microbes that are resistant to specific therapies such as a particular antibiotic can be selected by repeated exposure. Such resistant microbes are often discussed as potential biological weapons. This is important for the human race, but we have to consider the dangers to livestock as well.

Prusiner presented a brief outline of some organisms and the diseases they can cause, as follows:

- Bacteria - anthrax, cholera, tuberculosis, botulism, plague, tularemia
- Rickettsia - Q fever, typhus
- Viruses - smallpox, ebola, foot and mouth, AIDS, Venezuelan encephalitis, tick-borne encephalitis, Rift Valley fever
- Fungi - coccidioidomycosis
- Prions - BSE ("mad cow"), Creutzfeldt-Jakob disease (CJD)

The United States and Biological Weapons

"The U.S. military 'weaponized' and stockpiled numerous biological agents, which were destroyed between 1971 and 1973," he said. These actions were done incompliance with international treaties at that time. The biological agents included the following:

- **Lethal agents**
  Bacillus anthraxis
  Botulinum toxin
  Francisella tularensis
- **Incapacitating agents**
  Brucella suis
  Coxiella bumetti
  Staphylococcus enterotoxin B
  Venezuelan equine encephalitis virus
- **Anticrop agents**
  Rice blast
  Rye stem rust
  Wheat stem rust

New Principles of Disease and Protein Structure

He went on to explain that viruses, viroids, bacteria, fungi, parasites, and prions can all be produced involving DNA or RNA genomes, noting that prions are much more tailored. They are infectious proteins that can cause diseases such as Kuru, Creutzfeld-Jakob disease (CJD), Gerstmann-Stäussler-Scheinker disease (GSS), Familial Insomnia (FI), Scrapie, Bovine Spongiform Encephalopathy (BSE) and Chronic Wasting Disease (CWD). Scientists were under the impression for years that these diseases (e.g., Scrapie) were caused by viruses, when in fact prions are the culprit.

Toxins for Bioterrorism

Prusiner then covered the topic of toxins that are available for bioterrorism. They include:

- Bacterial toxins - botulinum, staphylococcal enterotoxin B
- Fungal toxins - trichothecene mycotoxin
- Plant toxins – ricin
- Snake toxins – cobra venom
- Puffer fish toxin – saxitoxin

"It is essential to look beyond human beings as vectors for bioterrorism," he added. "We absolutely must consider livestock, rodents, insects, and microbes as well."

Estimates of Casualties produced by Hypothetical Biological Attack

The table on the right takes into account the release of 50 kg of agent (infectious pathogen) upwind from a population of 500,000. On exposure to anthrax, for example, an estimated 95,000 people will die and another 125,000 will become incapacitated.

Infectious Pathogen	Downwind * Reach (km)	Number Dead	Number Incapacitated
Rift Valley Fever	1	400	35,000
Tick encephalitis	1	9,500	35,000
Typhus	5	19,000	85,000
Brucellosis	10	500	125,000
Q fever	>20	150	125,000
Tuaremia	>20	30,000	125,000
Anthrax	>20	95,000	125,000

*(*Release of 50 kg of agent by aircraft along 2 km line upwind of a population center of 500,000)*

Commenting on the table, Prusiner said, "The disconcerting fact is that it is not difficult to make 50 kilograms of anthrax, and it is a very significant biological weapon. What makes anthrax a doubly serious threat is that it exists in two states – namely, the vegetative state and the spore state. The latter is extraordinarily stable, even under difficult conditions and can be dispersed very easily in solid form. This makes it a very good choice as a biological weapon."

Vectors implicated for bioterrorism include not only microbes, but insects rhodents, livestock and humans.

Organized Science and Bioterrorism

Prusiner then turned to the subject of the role of the physician and the scientist as crucial in the effort to counter bioterrorism. "First and foremost," he said, "we need a good public health surveillance system." Such a system, he explained, would monitor the following:

- All illnesses
- Air quality
- Water supply
- Food supply, including livestock and plants
- Blood supply

Then he pointed to the need to prevent and treat the consequences of bioterrorism by way of:

- Antibiotics - judicious use is mandatory to prevent resistant microbes from emerging
- Anti-sera - purified fractions may decrease side effects
- Vaccines - purified recombinant proteins may decrease side effects
- Air purification for relatively closed environments, such as passenger airplanes, airports, large office buildings, and hotels

Prusiner is convinced that in order to counter bioterrorism, it is essential to build a public health system capable of identifying and responding to biological attacks immediately with the aid of 1) trained personnel; 2) precise, rapid laboratory tests; and 3) effective treatments in adequate supply and to build a research system that will anticipate new biological weapons. In so doing, we have to 1) develop rapid, reliable laboratory tests, and 2) develop effective preventative measure and/or treatments.

"To develop scientific and medical leadership for countering bioterrorism, it is not only essential to identify scientists and physicians with the appropriate background and training, but also to ascertain that these individuals can be counted on to remain engaged, and to build on their vision, imagination, and talent. That is one challenge.

He reminded the audience that vast human and physical resources have been developed in the U.S. over the past century, with many highly trained biomedical scientists and physician-scientists in academic medical centers. Many of these individuals already have the skills and talents needed. "From among these scientists and physicians," he said, "we need to assemble a group to provide the required leadership, oversight, and vision. Governments generally do not have a sufficiently large cadre of talented individuals to fill such positions and therefore we must look to the faculties

Anthrax Virus

Scientist manipulating Anthrax Virus

of our best universities."

Prusiner used the example of the historic Manhattan Project as a model for our current needs, but with notable differences. For one thing, the Manhattan Project had a well-defined goal – to build an atomic bomb. Also, the Manhattan Project assembled best scientists in the U.S. "However, countering bioterrorism is a more diffuse, long-term project," he said, "which is defensiverather than offensive in nature, and for which it is far more difficult to attract top scientific talent. The project that I am proposing could probably be turned into an offensive one, at least in part."

Prusiner returned to the notion that our best universities are the primary source of the talent needed to counter bioterrorism. "It is therefore necessary to develop a government-academic partnership, a Bioterrorism Government-Academic Leadership Council (BGALC), which will take the lead in the response to any biological assault, through innovation, vitality, and responsiveness. By definition, the BGALC would also provide the necessary leadership, oversight, and vision in what will be a sustained, long-term effort. Similar councils should be set up to counter chemical weapons and IT warfare. All three councils would interact on a regular basis.

Hazardous material crew members wash off

Some of the major challenges in creating an effective strategy for countering bioterrorism include the following points:

- Bioterrorism is a long-term problem. There are no effective quick fixes
- BGALC should be extremely well funded and well organized, with great imagination
- Academic scientists are often reluctant to participate in highly structured activities
- The issues surrounding bioterrorism tend to be applied, rather than basic
- A sustained, focused effort is necessary

In addition to the physical aspects of bioterrorism, there is the psychological one. Prusiner noted that besides the actual cases of disease caused by biological weapons, fear of disease may prove to be even more devastating. "This is psychological bioterrorism!" he said. "Many more people may feel ill than those who actually are ill after exposure to a bio-weapon. The economic and political consequences of psychological bioterrorism can be as devastating, if not more so, as actual cases of disease. To minimize the psychological effects of bioterrorism, the public must be educated and become confident that our defenses against bioterrorism are superb."

Summary

Professor Prusiner concluded with the following key points:

- Scientific advances are creating a constantly enlarging pool of potential weapons, from which the terrorist can choose
- Genetic engineering allowsfor entirely new, artificial biological weapons to be created
- Building a system of defense against such unprecedented weapons will require great skill, vision and imagination. Developing an offensive posture may prove crucial.

Professor Stanley Prusiner