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Biological Warfare

Philip H. Abelson

During a recent talk at the American Association for the Advancement of Science, Frank Young, former commissioner of the U.S. Food and Drug Administration and director of the National Disaster Medical System, said that it is almost certain that at some time in the future we will experience a terrorist attack with biological weapons. Authorities have been aware of this risk for many years. In 1991, chemical and biological weapons were discovered in Iraq's arsenal. Reports of deaths as the result of anthrax leaked from a military facility in Sverdlovsk, Russia, and from sarin released by a cult in Tokyo, Japan, added to concerns. A large number of toxic or infectious agents have been identified as possible weapons, including bioengineered microorganisms, and the recipes for making many of them can be found on the Internet. However, despite efforts by the Clinton Administration to improve defenses, a large imbalance currently exists between the ease of attack and the ability to minimize an attack's effects.

> **"This country has the scientific and engineering talent to minimize the threat of biological terrorism."**

Methods for identifying dangerous organisms already exist in the laboratory. However, the tests require lengthy procedures, expert technicians, and wet-laboratory environments with perishable reagents. Several organizations, including the Defense Advanced Research Projects Agency (DARPA) and the Defense Threat Reduction Agency Chem/Bio Directorate (DTRA), are sponsoring research on rapid identification of lethal organisms, which will facilitate appropriate emergency medical responses.

There are many examples of relevant technological approaches, but examination of one recent development can indicate the potential of the field. With support from DARPA and DTRA, The Johns Hopkins University Applied Physics Laboratory (APL), The Johns Hopkins School of Medicine, The Johns Hopkins School of Hygiene and Public Health, the University of Maryland, and several contractors have been developing and testing a small, portable mass spectrometer designed to rapidly collect aerosol samples and identify biological substances.* A goal of the system is to detect aerosols containing dangerous organisms in less than 5 minutes. One difficulty has been sample preparation—a rapid interface between air sampling and analysis in a vacuum environment is needed. To solve this problem, air samples are concentrated, and aerosols are collected onto a continuous tape feed. These samples are fed in stages into a small vacuum chamber that is quickly evacuated. Matrix-assisted laser desorption ionization is used to desorb and ionize large biomolecules, and the ions then enter the time-of-flight (TOF) mass spectrometer. Detailed analysis of the mass distribution of a molecule and its fragments can sometimes be done at the 10^{-18} mole level. To support the system, a database of biological warfare agents is being assembled, and valuable reference information is being acquired through laboratory research on less pathogenic relatives of lethal organisms. Improved models of the portable TOF mass spectrometer have been developed that can operate unattended, are light in weight, and drain little power. They are scheduled to undergo testing with nonpathogenic microorganisms at the U.S. Army Dugway Proving Grounds in 2000. Successful results could lead to large-scale manufacture and wide distribution of the instruments to military and civilian agencies.

This country has the scientific and engineering talent to minimize the threat of biological terrorism. The United States should tap into its broad range of technological expertise in this area and make it clear to would-be users that we are making a long-term commitment to developing defensive technology. The commitment itself may be one of our most effective means of discouraging the use of such weapons.

*More details of the R&D efforts at APL are included in the *Johns Hopkins APL Technical Digest* **20**, no. 3 (July-September 1999). Information is also available at www.jhuapl.edu/digest/. A description of many other DARPA activities appeared in *Science* **285**, 1476 (1999).