Box 3-B-Anthrax as a Biological-Warfare Agent

Anthrax, a severe illness caused by the bacterium *Bacillus anthracis,* is considered the prototypioal biological-warfare agent. In nature, anthrax is primarily a disease of cattle and sheep but can also infect humans. it can survive for long periods in soil in a dormant (spore) phase; after infection, it reverts to an active phase in which it mulitipiies rapidly in the body and secretes fatal toxins. Natural human infection can result either from skin contact with infected animals, ingestion of contaminated meat or inhalation of anthrax spores, usually from contaminated hides. Cases of pulmonary-and in some outbreaks gastrointestinal--anthrax are almost invariably fatal if not **treated immediately with antibiotics. Inhalation of aerosolized spores would be the primary route of infection if the bacteria were used deliberately as a biological-warfare agent. As extrapolated from animal studies, inhalation of about 1,000 spores or less can produce fatal pulmonary anthrax** in some members of an exposed **population,** while inhalation of about 8,000 spores-weighing about 0.08 microgram-is fatal within less than a week to a large proportion of those exposed.[1]

After inhalation into the lungs, anthrax spores travel to the lymph nodes of the chest, where they become active, multiplying and releasing three proteins-edema factor, lethal factor, and protective antigen. in specific combinations, these proteins function as potent toxins, enabling the bacteria to resist host defenses and to invade and damage host tissues via the bloodstream, resulting in uncontrollable hemorrhaging. in this manner, anthrax bacteria travel to the intestines and other areas, where they cause severe tissue damage. Initial signs of pulmonary anthrax infection include a high fever, labored breathing, choking cough, and vomiting; it is usually fatal within 4 days.[2] Although infections may respond to immediate antibiotic therapy, it is relatively easy to develop antibiotic-resistant anthrax strains.

in addition to its lethality, anthrax has other characteristics that make it an effective BW agent. First the disease is not contagious from one individual to another. As a result, anthrax would not spread far beyond the intended target or boomerang against the attacker's troops or civilian Population, assuming they do not enter a contaminated area Second, anthrax is easy to produce. The organism and its spores can be readily produced

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1 Testimony by Barry J. Erlick, Biological Weapons Analyst, Department of the Army, in U.S. Senate, Committee on Governmental Affairs, *Global Spread of Chemical and Biological Weapons: Assessing Challenges and Responses,* 101st Congress, First Session, Feb. 9, 1989 (Washington, DC: U.S. Government Printing Office, 1990), p. 32.

2 Philip J. Hilts, "U.S. and Russian Researchers Tie Anthrax Deaths to Soviets," *New York Times,* Mar. 15, 1993, p. A6.

in the laboratory in almost unlimited quantities, and antibiotic-resistant strains have been developed with standard selection techniques. [3]

Third, when anthrax bacteria are incubated under particular conditions, they transform themselves into the rugged spore form, which has along shelf-life. Although most spores can be killed by boiling for 10 minutes, they can survive for up to 20 years or longer in soil and animal hides.[4] This spore-forming ability makes anthrax particularity well suited for delivery by missiles or bombs. The spores are stable when suspended in air, can survive explosive dissemination from a bomb or shell, and-unlike most pathogens-will live for several days if direct sunlight is avoided. Indeed, fieldtest data have shown that anthrax spores decay at a rate of less than 0.1 percent per minute, which is very slow for a microorganism.[5]

Nevertheless, anthrax has certain liabilities as a tactical weapon. First, at lower doses there is a wide spread in incubation times, ranging from a few days to several weeks, suggesting that the spore germinations that result in infection can be delayed for considerable periods.[6] This variability greatly reduces the predictability and hence the military utility of the agent. Second, anthrax spores are so persistent that they can contaminate an area for long periods, denying it both to defender and attacker. During World War II, for example, Britain detonated experimental anthrax bombs on Gruinard Island off the coast of Scotland, releasing spores that remained in the top 6 to 8 inches of soil for more than 40 years.[7] By infecting livestock, anthrax bacteria might also create new reservoirs of disease that could result in occasional outbreaks, making it impossible to use the affected area productively for long periods.[8] That might be the desired intent, however, were anthrax to be used as a strategic weapon.

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3 World Health Organization, *Health Aspects of Chemical* and *Biological Weapons* (Geneva: WHO, 1970), p. 74.

4 Donald Kaye and Robert G. Petersdorf, "Anthrax," Eugene Braunwald et al., eds., *Harrison's Principles of Internal Medicine,* 1 Ith ed. (New York, NY: McGraw Hill, 1987), p. 557.

5 World Health Organization, op. cit., footnote 3, p. 94.

6 presentation by Matthew Meselson, Harvard University, at Seminar on Biological Weapons in the 1990s, sponsored by the Center for Strategic and International Studies, Washington, DC, Nov. 4, 1992.

7 These explosive anthrax bombs were crude and inefficient in creating an aerosol cloud composed of small particles. Instead, the bombs compacted the spores into the ground. Effective BW munitions would not do this. William C. Patrick III, former program analysis officer, U.S. Army Medical Research Institute of Infectious Diseases, Fort Detrick, MD, personal communication, 1992.

8 World Health Organization, op. cit., footnote 3, p. 75.