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The United States began its Biological Warfare (BW) Program in 1942. The offensive aspects of the program were stopped by Presidential Directive in 1969, and by 1973 the U.S. had destroyed all of its BW offensive capabilities. Today only defensive work continues.

The policy of the United States regarding biological warfare between 1941 and 1969 was to first deter its use against the United States and its forces, and secondly, to retaliate if deterrence failed. Fundamental to the development of a deterrent strategy was the need for a thorough study and analysis of our vulnerability to both overt and covert attack, and an examination of the potential range of retaliatory options. From its inception, the program was characterized by continuing in-depth review and participation by the most eminent scientists, medical consultants, industrial experts, and government officials.

Prior to 1977, the BW program was classified up to Top Secret. In 1977, most aspects of the program were declassified, and information related to the program was released to Congress and the public. Congressional hearings were held on this subject, beginning 8 March 1977, and concurrent with the hearings, the Army released an unclassified report titled, "U.S. Army Activity in the U.S. Biological Warfare Programs." The report contains extensive information on the dates and locations of tests, types of agents and simulants used, and rationale for the U.S. biological program.

The BW warfare program was concerned principally with antipersonnel and anticrop agents and associated delivery capabilities, and to a lesser degree antianimal agents. Biological testing was conducted in laboratories, closed chambers, open air field (large scale), and used both simulants and pathogens. The open air field testing was conducted in the continental U.S. and extra continental and in both public and non-public domains (military installations). The Biological Warfare program also included human volunteers under a codename "Operation Whitecoat."

Antipersonnel agent research covered a wide range of highly infectious pathogenic bacteria, rickettsial, viruses, and fungi, and extremely toxic products of biological origin (toxins). Research efforts were directed toward selecting and preserving the most virulent strains, establishing human dosages, enhancing storability, and survival when released as an aerosol. Technology for large scale production of the most promising agents was developed. Numerous field trials with actual pathogenic agents were conducted at Dugway Proving Ground, Eglin Air Force Base, Fort Detrick, and a farm owned by the University of Wisconsin. The testing agents included Coxiella burnetii, Pasteurella pestis, Brucella suis, Pasteurella tularensis, Brucella melitensis, Clostridium botulinum toxin, Coccidioides, Hog Cholera, and New Castle Disease. Human test subjects were not used as a part of these trials.

Total destruction of antipersonnel BW stocks was accomplished between 10 May 1971 and 1 May 1972. They were destroyed by pasteurization at 160 degrees for one hour and then further sterilized at 280 degrees for three hours. The facilities were completely

decontaminated and turned over to the Food and Drug Administration to become the National Center for Toxicological Research.

Open air vulnerability tests were conducted using BW simulants and certain selected inorganic materials such as fluorescent particles. Hundreds of simulant tests were conducted. Human test subjects were not used; however, due to the scale of some tests, humans were exposed to simulants. The number of humans subjected to exposure is unknown.

The two most commonly used biological simulants were Serratia marcescens (SM) and Bacillus subtilis varian niger, normally referred to as Bacillus globigii (BG). SM was used as a bacterial marker, and is commonly found in water, food and sewage. In 1969 it was recognized as having limited pathogenic capability and was not used for study of experimental infection in man. BG is considered ubiquitous in nature. It can be readily cultured from hay, dust, milk, and water. It was considered by medical authorities to be harmless to man and is still used today in BW defensive programs. Aspergillus fumigatus (AF), a fungus simulant, was used on four occasions in open air tests from 1950-1953 and abandoned when antifungal agents were removed from the BW program. AF is ubiquitous in nature and is considered an opportunist causing aspergillosis in debilitated persons. Urafine dye, lipstick, and talc were also used as antipersonnel agent simulants. The most commonly used fluorescent particle (FP) was an inorganic complex known as zinc cadmium sulfide. The U.S. Army Center for Health Promotion and Preventive Medicine (formerly the Army Environmental Health Agency) recently completed three Health Risk Assessments for three cities involved in FP aerosol testing. In all three cases, the assessments concluded that the level of risk experienced by inhabitants in the test areas was below the 1994 Occupational Safety and Health Administration (OSHA) standards. Additionally, the assessment concluded that the risk of exposed individuals developing cancer is below the accepted level of risk established by the U.S. Environmental Protection Agency for the general population. In August 1994, the Center for Disease Control and Prevention, in an independent review of the study, concluded that zinc cadmium sulfide tests conducted by the Army posed negligible health threats to residents of the test areas.

The vulnerability tests are outlined in the 1977 report, and include simulant testing in both public and nonpublic domains. The first large area vulnerability test was conducted in San Francisco, California, in September 1950, using simulants BG, SM, and fluorescent particles. The first open air sea tests were conducted in the Atlantic Ocean using simulants BG and SM. In 1957 and 1958, the Army conducted its largest vulnerability test, Operation Large Area Coverage (LAC). The testing area covered the United States from the Rockies to the Atlantic, and from Canada to the Gulf of Mexico in four separate testing phases. These tests used the fluorescent particle zinc cadmium sulfide to determine the distance and direction of disbursement. The objective of LAC testing was to determine the logistics and feasibility of contaminating a large area with BW agents. Other large area vulnerability tests were conducted in Minnesota, Missouri, Texas,

Florida, Utah, California, Indiana, Arkansas, Maryland, and along the eastern and western coastlines of the United States.

Anticrop BW research included agent strain selection, evaluation of nutritional requirements, development of optimal growth conditions and harvesting techniques, and prepared agents in a form suitable for dissemination. Extensive field testing was done to assess the effectiveness of agents on crops. Many candidate anticrop BW agents were screened resulting in five standardized BW anticrop agents that included various stem rust of wheat and rye, and rice blast. Human test subjects were not a part of this program. Over 25 anticrop tests were conducted. Total destruction of anticrop agents and decontamination of facilities was accomplished between 19 April 1971 and 15 February 1973.

Antianimal simulant tests were conducted as part of the Biological Warfare Program. The tests examined the vulnerability of animal stockyards to covert BW attacks. The testing involved aerosol deodorant and posed no health risk to humans or the animals. At least six tests were conducted.

It was determined in 1952 that while tests with simulants had demonstrated the vulnerability of the U.S. to biological attack, no scientific data was available to assess human vulnerability to biological agents. A Human Volunteer Testing program was established, and examined the vulnerability of man to biological agents, prevention and treatment of BW casualties, and identification of biological agents.

The 1977 "U.S. Army Activity in the U.S. Biological Warfare Programs" report includes a historical review of the Human Volunteer Testing program. From 1954-1976 the U.S. Army Medical Research Institute of Infectious Disease conducted human BW test studies with more than 2000 volunteers. The program volunteers were assembled from active duty military, research team members, and civilians. Civilian volunteers were selected from personnel who maintained conscientious objector draft status, the majority of which were members of the Seventh Day Adventist Church. Numerous testing protocols included human testing with Coxiella burnetii, Tularemia, Rift Valley Fever, Venezuelan Equine Encephalitis, Pasteurella tularensis, Bacterial Endotoxin, Bolivian Hemorrhagic Fever, Q Fever, Sandfly Fever, Plague vaccine, Yellow Fever, Adenovirus Vaccine, Chikungunya Vaccine, Western and Eastern Equine Encephalitis Vaccine, Rocky Mountain Spotted Fever Vaccine, and Influenza Virus Vaccine. The Report also indicates that 21 classified projects were conducted during this period.

The U.S. Public Health Service closely followed the progress of BW research and development from the very start of the program. The Surgeon General of the Army maintained close liaison with medical personnel right on the scene working within the research and development laboratories. In 1956, the Army Medical Unit was established at Ft. Detrick with the mission to conduct defensive R&D including prophylactic and therapeutic measures, more rapid effective diagnostic and identification procedures and to evaluate the threat of BW to the military from a medical point of view.

The safety and medical aspects of testing with biological material were of overwhelming concern to management from inception of the BW program, primarily because of the many unknown factors, and the potential severe danger to employees as well as the local community. A major safety organization was always established along with the operation organizations. Since many of the early aspects of the safety and medical program were of necessity experimental, it was necessary to confer with and have the approval of the Surgeons General of the military services for much of its operations. U.S. Public Health Service maintained oversight of the program and provided advice on public health.

The concern for safety and medical aspects is further noted by the deliberations of various external advisory committees such as "The U.S. Biological Warfare Committee" (Merck Committee) in 1942, and the Committee on Biological Warfare of The National Military Establishment Research and Development Board (Baldwin) in 1948. With the advent of the requirement to determine the field environment effects such as varying temperature, humidity, terrain, to include structures, sunlight, winds, etc., on BW agents, independent external advisory committees were formed to review, comment upon, and make recommendations concerning test protocols. The committees were "The Ad Hoc Committee on BW Testing" (Scheele Committee - 1953), and "The Interagency Survey Committee on BW Testing" (Price Committee - 1959). The members of these committees were eminent authorities in their fields of biological and medical sciences and were drawn from various universities, federal, and state agencies.

These pioneering efforts subsequently became the foundation for infectious disease safety procedures, techniques and equipment throughout the scientific and industrial communities in the world. Information gained from BW Warfare Program has been of value not only to the military, but also to public health, agriculture, industry, and the fundamental sciences. Today's defensive program continues, and seeks to further develop effective warning and detection devices, protective clothing and equipment, and continues to assess the vulnerability of the U.S. and its force to enemy BW threat.

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