Risk and Biological Defense Research

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During the Persian Gulf war, fears that Iraq had biological weapons heightened concerns about U.S. defense capabilities. For some analysts, the war underscored the importance of the Army's Biological Defense Research Program (BDRP) [1]. Yet an examination of the program raises questions about its risks to the American public, the Army's denial of these risks, and whether the BDRP has prompted other countries to develop military biological programs.

The nature of biological warfare, which involves the purposeful spreading of disease, creates unease about any military research in that area. This has been especially true during the past decade as biotechnology has advanced the capability of creating novel pathogens for which there are no vaccines.

But an overview of the safety, legal, and psychological-political implications of the BDRP reveals concerns that are valid in their own right. The three aspects are related. Indeed, psychopolitical dangers of the BDRP—manifested as the public's loss of confidence in the word of the Army—are born of safety and legal questions. This paper reviews the three separately, however, to better understand each.

SAFETY RISKS

The U.S. biological warfare program was established under Army authority during World War II. Since 1969, when President Richard Nixon renounced the country's biological warfare capability, the program has been limited officially to defensive activities. As the BDRP expanded during the 1980s, however, scientists, physicians, and other members of the public became concerned about its safety. In response to a 1986 court suit by the Foundation on Economic Trends, an organization critical of genetic engineering, the Army agreed to prepare an environmental impact statement on its biological defense program.

In 1989, the Army released an 875-page *Final Programmatic Environmental Impact Statement*, which concluded that existing controls provide "adequate protection for the workforce and virtually total protection for the external environment." The program was "thoroughly analyzed," the report said, and "additional mitigation was not found to be justified" [2].

According to the report, conditions have never been safer at Fort Detrick, Maryland, which has been a principal location for military biological research since 1943. Through 1969, 419 incidents of illness related to the program were reported at the base, compared with five in the 1970s and 1980s. The statement further contends that no member of the public has ever been infected by a Fort Detrick experiment and that only three workers there ever died from infections: two from anthrax in 1951 and 1958, and a third from Bolivian hemorrhagic fever in 1964 [2].

These contentions are marred, however, by incomplete information. For example, Charles Dasey, a spokesman for Fort Detrick, acknowledged elsewhere that a janitor at the base died from anthrax

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infection in 1968 [3]. The victim was exposed while changing a light bulb in a building that was contaminated with the bacteria. Omitting this fatality from the Army's tabulation raises questions about how many others may be missing as well. Moreover, the location was only one of several "hot spots" at Fort Detrick and Dugway Proving Ground in Utah, some of which remain contaminated [4,5]. None is mentioned in the Army's environmental impact statement.

Missing also is any allusion to the health consequences of earlier and current projects around the country. The most dramatic involved exposing millions of unwitting citizens to bacteria and chemicals in simulated biological warfare attacks in the 1950s and 1960s. Although the possibility of illness from these tests has been documented, the Army never monitored the health of the exposed population [6]. The Army continues an open air testing program with "simulants" (microorganisms that are less harmful than biological warfare agents) at Dugway Proving Ground, 70 miles from Salt Lake City. In addition, more than 100 outside contractors are now conducting biological defense projects. As noted below, much of this work has taken place in the absence of a safety monitoring system.

Federal law requires that public comments be considered in the preparation of an environmental impact statement. In consequence, the Army's 1989 *Final Programmatic Environmental Impact Statement* was preceded by a draft in 1988 that invited comments from the public [7]. The final statement and the draft were virtually identical, except that the final version included a 189-page appendix that summarized the comments and the Army's responses.

The comments, whose sources were not identified, revealed concerns about accidental releases of pathogens during shipment or in the laboratory, outdoor aerosol testing, security, the threat of novel organisms, and the possibility of defensive work slipping into offensive. The Army's response to each comment invariably sought to demonstrate that concerns were unjustified. The response to those who worried about accidents was typical. It referred the reader to another section of the statement headed "Unexpected External Event," which was intended to eliminate all doubts. The section read in part:

> No plausible combination of human error or mechanical failures can be conceived that would result in materials being released because of the design and redundancy of control systems, safety procedures, and mitigating and monitoring steps [2].

The phrase was precisely the same in both the draft and final statement, as were the concluding words of assurance in each—protection is adequate or total, and additional mitigation is unnecessary.

Congressional Hearings on Safety, The Levitt Case

Yet between the time of the draft and final environmental statements, a congressional committee held hearings on the subject. In July 1988, witnesses before the Senate Subcommittee on Oversight of Government Management gave testimony that contrasted sharply with the Army's contentions. The hearings were prompted by a report that subcommittee staff members had issued in May. After an 18-month review, they had found "serious failings" in safety management of the Pentagon's chemical and biological weapons research programs [8,9].

In his opening statement at the hearings, subcommittee Chairman Carl Levin indicated that "there is a disturbing record of safety problems at chemical research facilities" and that "the biological side has been in even worse shape." Among the problems with the biological program:

> There has been no readily identifiable organizational structure within DOD [Department of Defense] for overseeing safety; contractor facilities were not prescreened; there was a confusing and inadequate patchwork system of safety regulations, and no DOD safety inspections [10].

Witnesses pointed out dangers associated with research on pathogens, whether for military purposes or not. Some who worked in the BDRP testified about health and safety failings at their facilities including unreported fires, accidents, and missing viruses and other biological materials. Neil H. Levitt, from 1969 to 1986 a microbiologist at the U.S. Army Medical Research Institute of Infectious Diseases (USAMRIID) in Fort Detrick, offered a compelling statement about his experiences. His mission from 1977 to 1985 was to develop a vaccine against the chikungunya virus, an organism considered by the Army to be a biological warfare threat. In 1980, he was instructed to grow an attenuated form of the virus in a special cell line of fetal rhesus lung cells. The Army had tried to develop vaccines previously by using the same cell line to grow other weakened viruses. It had to abandon those efforts, however,

because the viruses reverted to lethal form after being inoculated into human subjects [11]. The subjects were volunteers from the professional staffs at USAMRIID and Walter Reed Army Hospital, Levitt said during a telephone inquiry on October 2, 1991

Tests suggested that similar problems were occurring with the chikungunya virus grown in that cell line. Two-thirds of the experimental mice died after receiving injections of fluid from those cells. Levitt informed his superiors about the problem and recommended in USAMRIID's 1981 annual fiscal report that the cell line not be used for human vaccine production. He was surprised to find that the results of his study as well as his recommendations were deleted from the version of the report sent to Congress: "Quite the contrary, only a glowing report of the vaccine's progress was discussed." He refused at that point to do further work with the cells toward vaccine production [11].

The stock of chikungunya virus that had been grown in the suspicious cell line was then stored in a freezer at Fort Detrick. During a routine inventory in September 1981, Levitt discovered that the entire stock was missing. He reported this to his department and division chiefs. They confirmed the disappearance of some 60 vials containing about 2,500 ml of virus, each milliliter with over one billion virus particles. His immediate supervisors and the USAMRIID safety officer refused to initiate a formal investigation, according to Levitt. In his 1988 testimony, he summarized his frustration:

> After three months of requesting administrative action and receiving none, my colleagues, including management level personnel, and I composed and signed a *Memorandum for Record* which documented a series of untoward events leading up to the mysterious disappearance of the chikungunya virus. Copies of the memorandum were sent to the Safety Officer and other administrative offices. To date, no satisfactory answer to how or why the virus disappeared or where it is, has ever been offered. . . . [T]he missing virus material possibly could have impacted serious consequences on the surrounding environment [11].

Levitt included a copy of the memorandum, dated December 1981, with his statement to the Senate subcommittee. The document confirms what he claimed in his testimony. It was signed by Levitt and three colleagues and indicated that copies had been sent to his superiors and the institute's safety officer.

Colonel David Huxsoll, who had been commander of USAMRIID since 1983, disputed Levitt's testimony. He told the subcommittee that shortly after the incident "an informal investigation lead [sic] management to conclude that the material had probably been destroyed through autoclaving as was directed" [12].

Senator Levin then read into the record the conclusion of a 1986 inquiry by the Army's Inspector General: "The inquiry, therefore, substantiated Dr. Levitt's allegation that no investigation was conducted into the disappearance of the virus" [10].

The Army included a description of the chikungunya incident in its 1989 environmental impact statement as a response to a comment about the missing vials:

> This alleged incident involving missing virus occurred in 1981 and has been the subject of several intensive investigations and occasioned a visit to the laboratory by a member of Congress—all investigations and inquiries concluded that the vials were not lost, but had been destroyed inadvertantly [sic], perhaps by the research team itself. Further, the allegedly misplaced vials contained an attenuated candidate vaccine virus and not a virulent organism [2].

That is the Army's response in its entirety. It suffers from error and innuendo. First, the missing virus incident was not "alleged" but was actual and denied by no one. Second, there is no evidence that "several intensive investigations" took place as the Army now claims. Neither Levitt's nor the Inspector General's contrary conclusions were mentioned in the response. Third, the suggestion that Levitt's research team destroyed the vials is gratuitous and without evidence. Finally, the Army's implication that the virus was harmless—"attenuated" and "not virulent"—ignores the reason it was placed in storage in the first place: the weakened virus had proved more virulent than expected.

Whether or not someone removed the vials to rid the Army of embarrassing evidence may never be learned. But the official explanation suggests, at the least, an effort to discourage serious inquiry.

Larger Uncertainties

If the Army's approach to specific safety incidents has seemed at times cavalier, the best characterization of the overall program is one suggested by a 1988 General Accounting Office (GAO) Report—uncertainty. Levin's subcommittee had requested the report to assess safety in the chemical and bio-

logical research programs. Even if protective practices in the biological areas were adequate, the report said, no one could be sure. That is because "in the biological defense program, DOD has not developed its own safeguard requirements or conducted regular, formal evaluations of contractor facilities." The 1988 GAO report recommended that a system of centralized evaluations for contractors be instituted. Meanwhile, in the absence of an effective evaluation process, "uncertainties will persist about the adequacy of existing safeguards governing biological research and development" [13].

Three years later, the GAO leveled new criticisms at the BDRP. In a report published in December 1990, it suggested that the Army was "unnecessarily" duplicating medical research underway at civilian agencies. Moreover, only 112 of the BDRP's 218 medical research projects could be confirmed as directed at biological agents that the Army had "validated" as biological warfare threats Conversely, several validated agents were not part of any research project [14]. Although the newer report did not revisit the safety issue, the GAO's findings fueled further skepticism about management practices in the BDRP.

In February 1991, the federal Occupational Safety and Health Administration (OSHA) added to the disquiet about the program's safety. The agency determined that the Army's safety inspection program of biological defense research activities "did not meet many of OSHA's inspection requirements" [15].

Meanwhile, in January 1991, the Army had announced the establishment of a new Biological Defense Safety Program and issued a pamphlet outlining the program's "technical safety requirements" [16]. According to William Wortley, the Army's designated contact person on the matter, the effort was in response to public concerns [17]. While no new safety practices were listed, the pamphlet was "a conglomeration of what was going on," he said in a telephone inquiry on September 23, 1991 The Army's laboratories and those of outside contractors "had been doing everything correctly," he said, but "we wanted to put it all under a single control."

Despite the new program, a gap persists between the Army's assurances of safety and the findings of outside observers. The discrepancy constitutes one of three principal sources of unease about the BDRP. A second involves questions of legality.

LEGAL RISKS

The Army emphasizes that its biological defense program is operated within the limits of international law The two pertinent treaties are the 1925 Geneva Protocol and the 1972 Biological Weapons Convention. The Protocol forbids the use of chemical or biological weapons. The Convention, to which more than 110 states are parties, prohibits even the possession of biological or toxin agents "of types and in quantities that have no justification for prophylactic, protective, or other peaceful purposes" [18]. Signatory states have interpreted this clause to mean that defensive research is permissible.

The Offense-Defense Dilemma

When considering the risk of violating international agreements about biological warfare, it therefore becomes necessary to distinguish between offensive and defensive research. Yet the difference between the two is not always evident. Like other military spokesmen, Major Michael Frisina believes an interpretation can be based on the quantity of bioagents being produced and whether or not delivery systems are being tested [19,20]. He supports a defensive program that requires production of a small number of pathogens to develop vaccines, protective gear, and detector systems.

But the knowledge gained from producing small numbers may be applied to developing larger numbers. Bacteria and viruses can reproduce so rapidly that small becomes huge in a matter of days. In this regard, the distinction between defensive and offensive work can be so transient as to be negligible

The presumption that an offensive capability requires the testing of delivery systems is also questionable. That might be true if the systems were limited to munitions and shells But in the 1950s and 1960s, the Army demonstrated the effectiveness of other methods in simulated biological warfare attacks. It conducted tests that exposed millions of Americans to bacteria and chemicals that were sprayed, for example, from a boat off the San Francisco coast, from automobiles traveling through St. Louis, and from bacteria-filled light bulbs tossed on the tracks of the New York City subway system [21–23]. The biological agents were easily dispensed and widely dispersed. The delivery equipment, whether in the form of wind generators or light bulbs, could be purchased at a local hardware store.

Before the U.S. decision to renounce its offensive biological warfare capability in 1969, the Army acknowledged the difficulty in distinguishing between offensive and defensive work. A 1968 booklet, prepared under the auspices of the Army's Technical Information Division at Fort Detrick, affirmed that "research and development in the offensive aspects of BW [biological warfare] proceeded hand in hand with defensive developments for, in truth, the two are almost inseparable" [24]. More recently, in 1991, Ronald F. Lehman, head of the U.S. Arms Control and Disarmament Agency, acknowledged that production of microorganisms and toxins "for offensive purposes is extremely difficult, and in some cases perhaps impossible, to differentiate from production for peaceful purposes" [25].

The Army's current contention that offensive and defensive activities are easily separable thus remains unconvincing. The development of a pathogen to test detection apparatus may be intended as a legitimate defensive activity. But it is also a step toward acquiring information for an offensive program. The dilemma has proved more challenging than anticipated when biological weapons were first banned by international agreement.

Growing Concerns

The Biological Weapons Convention came three years after Nixon's renunciation in 1969 of the U.S. biological warfare capability. The 1972 Convention called upon all signatories to prohibit any biological weapons capability: signatory powers undertake "never in any circumstances to develop, produce, stockpile or otherwise acquire or retain" biological weapons or the means to deliver them [18]. Yet no matter how sincerely the Army might try to adhere to these strictures, its activities in the area face intractable questions. This has become increasingly apparent in the past decade.

From the time that recombinant DNA techniques were introduced in the early 1970s, scientists recognized their potential military implications. Initially, many felt that the Biological Weapons Convention offered sufficient protection against the military misuse of biotechnology, and the subject received little attention. But in the early 1980s, more scientists began to express concerns about the Army's blossoming interest in genetic engineering research and its relationship to the Convention [26–28]

Worries about the Army's program and the possibilities of its violating the Convention continued into the 1990s. The concerns prompted congressional enactment in 1989 of the Biological Weapons Anti-Terrorism Act, which was signed into law in 1990 [29]. The Act mandates life imprisonment for violating the Biological Weapons Convention. A spokesman for the Army's Research and Development Command at Fort Detrick said that the military had always operated within the terms of the Convention and was therefore in compliance with the new legislation [30]. His remarks were in response to a memorandum by Francis Boyle, a law professor at the University of Illinois, who disagreed. Dated October 23, 1990, the memorandum was circulated to several scientists by the Boston-based Council for Responsible Genetics.

Boyle suggested that all researchers and others connected with the BDRP seek legal advice "as to whether or not they should proceed with their research or grant applications." An adviser on the drafting of the act, he offered the most pointed of warnings about the legality of the BDRP: "In my professional opinion, many research projects that have already been funded by the Department of Defense's so-called Biological Defense Research Program (BDRP) raise serious compliance problems with the Biological Weapons Convention and thus with this Act."

In line with this presumption, others have cited Army projects to develop toxins and antibiotic-resistant strains of the anthrax bacillus as lying "outside the permitted range of the BDRP's mission and activities" [31] and as being "highly ambiguous, provocative, and strongly suggestive of offensive goals" [32].

Perhaps the most regrettable consequence of an enlarged U.S. defense program is that it may have encouraged others to develop military-biological programs that they otherwise would not have. The more nations that undertake their own programs, the greater the likelihood that activities will spill over into indisputably offensive work. Indeed, as the U.S. BDRP grew throughout the 1980s, more nations were becoming interested in a weapons system that a decade earlier seemed nearly extinct. The only nation publicly alleged by the U.S. to have a biological weapons program in 1980 was the Soviet Union (though even in this case the evidence was questionable [33]). But in 1989, CIA Director William

Webster reported that "at least 10 countries are working to produce previously known and futuristic biological weapons" [34]. As noted by military analyst Seth Carus, several of these countries are parties to the Biological Weapons Convention, and their actions are a violation of its terms [35].

An aim of the BDRP has been to deter others from illegally developing biological weapons, said a supporter of the program in 1990 [36] Judging from the mushrooming interest of other nations, that goal has not been realized If anything, the U.S.'s expanding biological defense program in the 1980s may have had the opposite effect as more states began to break international law

PSYCHOLOGICAL-POLITICAL RISKS

The BDRP has prompted disquiet among several segments of the public. This disquiet may be attributed in part to the legacy of earlier research programs, including the Army's tests in American cities that the public learned about in the 1970s The Army said that they were no longer being conducted but that there might be a need to resume them in the future [37]. Knowledge of the tests created a veil of suspicion that has shadowed subsequent biological defense activities.

In the 1980s, the Army was found to be shipping dangerous biological agents through the mail [37a] and was accused of safety lapses in the overall program, as discussed above. Research financed by the DOD at the University of Massachusetts in Amherst convinced some critics that "the aim is to infect populations in unfriendly countries with anthrax" [38]. In March 1989, a coalition of Massachusetts Quakers, physicians, and others called on the university to halt the research [38]. During the following months, students rallied, went on hunger strikes, and occupied buildings--more than 100 were arrested [39,40]. By the end of the year, the issue had dissipated as the BDRP project grant expired.

Meanwhile, in 1990, an odd incident involving another civilian facility was taking place. Ivan Kaiser, a molecular biologist at the University of Wyoming, had applied for a grant to conduct research at a new Department of Agriculture laboratory in Laramie, Wyoming. The laboratory was one of the few Biosafety Level 4 (BL 4) facilities in the U.S., where work could be done with the most dangerous biological materials. Unknown to Thomas Walton, the laboratory's research leader, Kaiser's funding was to come from the DOD. The grant application had led Walton to believe that the sponsor was the National Institutes of Health. After learning of the discrepancy, Walton repudiated the DOD connection. In communication with Edward Lee Rogers of the Council for Responsible Genetics in March 1991, he made clear that Kaiser's project would not be carried out in his laboratory.

Testing at Dugway

No recent military project has provoked more protest than the Army's biological testing program at Dugway Proving Ground in Utah. Controversy began in 1984 over the manner in which the Army sought funds to build an aerosol test facility there. Rather than have the planned laboratory subjected to public scrutiny through congressional hearings, the Army tried to obtain a reallocation of funds from existing projects. The facility was on a list of innocuous projects including military houses and garages. Two months after the reprogramming had been approved by the ranking members of the House and Senate appropriations committees, one of them, Senator James Sasser, withdrew his assent. He belatedly recognized that the facility could be used "to test offensive biological and toxin weapons, a capability which is prohibited by a 1972 treaty" [41].

Sasser's concern was echoed by others in Congress, the media, and the public. Responding to a suit by the Foundation on Economic Trends, the Army issued an environmental assessment. In 1985, a federal court judge ruled that the assessment was superficial and enjoined the Army from proceeding with the test facility until it provided a thorough environmental impact statement [42]. The Army reluctantly agreed to the court order but indicated that the statement would require several years to prepare. (The environmental impact statement regarding the laboratory was distinct from the *Final Programmatic Environmental Impact Statement* on the overall Biological Defense Research Program.)

By the time the Army issued a draft environmental impact statement on the test facility in January 1988, discontent among Utah residents had turned to resistance. Criticism focused on the Army's plan to build the facility at the highest containment level possible, BL 4. This would allow for experiments with genetically engineered organisms and other

pathogens for which no vaccine exists, although the Army said it had no plans to test such agents. Rather, the Army said it just wanted an extra measure of safety.

Many residents of the state remained unconvinced. Elected officials from both political parties voiced misgivings, including Republican Senator Orrin Hatch and Democratic Congressman Wayne Owens, who represents Salt Lake City. The state's Republican governor, Norman Bangerter, announced that he was "adamantly opposed" to the project [43]. Salt Lake City's major newspapers applauded the governor's stance. In doing so, their editorials cited past Army projects about which the public could feel little confidence—purportedly safe nuclear tests that caused cancer, the accidental killing of 6,000 sheep from nerve gas that floated out of Dugway in 1968, and the simulated biological warfare attacks in populated areas around the country [44,45].

Protests continued throughout 1988, as hundreds of people attended meetings to express opposition to the lab. More than 140 University of Utah biologists and physicians signed a petition to protest the Army's research plans. As a result of public and political pressure, at the end of the year the Army withdrew its plan for a BL 4 facility at Dugway and announced that it would build a lower-level BL 3 laboratory [46]. Public agitation tapered off, but, in 1991, when the Army announced plans for further tests at Dugway, protests were revived.

The new round was triggered by an Army news release on May 2, 1991, announcing that in June it would test "simulant materials" outdoors and pathogens indoors at Dugway. The purpose would be to evaluate the performance of biological detector systems. The "simulant materials" included Bacillus subtilis var. niger and coliphage MS2 virus, which would be sprayed into the open air. Consistent with its previous practice of minimizing in public the potential of its simulants to cause disease, the Army labeled the bacteria and viruses "materials" rather than biological agents or microorganisms. Other more infectious agents that would be tested in containment areas were Yersinia pestis, which causes plague, and Coxiella burnetii, which causes Q fever. Three toxins would also be tested indoors: botulinus toxin, staphylococcal enterotoxin B, and the mycotoxin T-2. At the conclusion of testing, the news release said, decontamination was planned that would include chemical, steam, and other sterilization techniques [47].

The Army's announcement was widely covered in Utah's news media. A newspaper reported the issue as one of risk versus gain, to be "mulled over by Utahns concerned about the testing of deadly germs and toxins--and potentially hazardous simulants" [48]. Although the proposed tests were reportedly approved by a biosafety group of federal and state officials, the state's Citizen's Advisory Committee for Dugway Testing was not consulted. The governor had appointed the committee in 1989 ostensibly to work with Dugway officials on testing protocols. The chairman of the committee, Kenneth Buchi, a professor of medicine at the University of Utah, said the Army seemed to have ignored this understanding (personal communication, July 31, 1991). University of Utah biologist Naomi Franklin doubted that the tests could be of value because a soldier would have to know what germs were in an enemy's arsenal before knowing what to test for [48].

On July 1, a citizens group called the Downwinders filed suit in federal court to stop the testing at Dugway. The organization, which had led efforts to seek accountability for the health consequences of the earlier nuclear tests, said that the biological tests show a "wanton disregard for the health and safety of the citizens of the State." In a news release in conjunction with their suit, Downwinders' director Preston Truman said that the state's residents "will not stand idly by and serve as guinea pigs in yet another deadly experiment" [49].

The motion for injunction, which was prepared by former Utah Senator Frank Moss, noted the legal dilemma that victims of past nuclear and biological tests had faced. Courts have consistently held that the government is not liable for damages from its defense programs. Therefore, residents who might suffer from the effects of the current tests "have no rights once they have been injured." The suit called on the court "to enforce their rights before they are injured, by the strict enforcement of health, safety, and environmental laws and regulations" [50]. The Utah Medical Association sought to file a brief in support of the suit. A federal court judge was scheduled to consider the suit and to rule on the medical association's request by the end of 1991.

Among the lapses cited in the suit was the Army's failure to train regional medical personnel to treat

people infected with any of the agents. In June 1991, the University of Utah Medical Center in Salt Lake City informed Army officials that it would not honor a contract to treat patients or perform autopsies on victims from Dugway who were contaminated as a result of the tests. The decision was taken because the Army had not fulfilled its agreement to train hospital staff in the medical management of chemical and biological operations patients [51].

The Army suspended the scheduled tests and agreed to begin a training program. The training amounted to two events. The first was a lecture in July that Kenneth Buchi characterized as "50 minutes of public relations and 10 minutes of medicine." Another physician in attendance, Zell McGee, said the university's physicians remained "completely unprepared" to deal with a biological testing accident at Dugway [52].

The second event involved a tour of Dugway in August by 22 physicians, nurses, and administrators from the University Hospital. Army personnel staged an accidental chemical munition "leak" and treated a "victim." The visitors then received a technical briefing [53]. Several doctors said afterward that they felt no better prepared to deal with victims of a testing accident. Nevertheless, Dugway officials issued a news release suggesting that the Army's obligation had been fulfilled: "An emergency response plan is in place and training is complete" [54].

Official Statements—Public Skepticism

Whether the Army can rebuild confidence in activities at Dugway, or in the overall biological military program, is uncertain. The weight of past mistrust is heavy, and current Army statements are often contradictory. An Army officer who considers the need to maintain the BDRP a moral imperative describes opponents as "people who have closed their minds" [55]. The condemnation not only ignores the questionable activities that have prompted public responses in recent years, but it also overlooks continuing contradictory statements from government representatives.

Thomas R. Dashiell, who worked in the biological defense program and later in the Arms Control and Disarmament Agency, exemplifies the dilemma in an article supporting the program. "The research program" at Fort Detrick, he writes, "is unclassified and available for public review *except for intelligence and vulnerability issues* [emphasis added] which, in any event, do not affect the scientific content of the program" [36]. Despite a disclaimer that his article expressed only his own views, the sentence reflects the official military position. The Army's 1989 *Final Programmatic Environmental Impact Statement* says that the entire BDRP is an "open UNCLASSIFIED program." The capitalized emphasis appears in section A15, page 143 [2]. Yet in section ES, page 1 of the same document, the Army says that research results in the BDRP may remain classified as they relate to "military deficiencies, vulnerabilities, or significant breakthroughs in technology" [2]. What the Army means by "deficiencies," "vulnerabilities," or "significant breakthroughs" is not described.

The confusion of definition was underscored in the most recent fracas over Dugway. While maintaining the Army dictum that the BDRP is unclassified, J. Gary Resnick, Chief of the Life Sciences Division at Dugway, said that the names of the organisms stored at the base were secret. The agents, to be used in biological defense tests, are kept in a freezer that Steven Erickson, a spokesman for the Downwinders, labeled "Pandora's icebox" whose secrecy "puts a lie to the claims of openness" [56].

Even if the Army's claims of innocence were valid, years of questionable policies have levied a psychological and political cost. Domestic concern about biological warfare activities, defensive or not, has remained intense since the mid-1980s. Some 4,000 scientists and others signed a 1985 petition opposing secret military biological research. The petition was prepared by the Council for Responsible Genetics (CRG) and warned that genetic manipulation under the auspices of the BDRP could lead to "the eventual production of new biological weapons." By 1991, more than 1,500 scientists had signed another CRG petition that asked biologists and chemists to pledge "not to engage knowingly in research and teaching that will further the development of chemical and biological warfare agents."

In 1989, the Utah Medical Association (UMA) called on the Department of Defense to address safety and health questions about the BDRP. The American Medical Association (AMA) echoed the concern of its Utah chapter and sought to have the Army address the issue directly. The following year, in a show of frustration, the House of Delegates of the AMA passed a resolution that included the

following:

> Whereas, Despite the efforts of AMA and Utah Medical Association working with representatives of the Department of the Army and Congress, none of the safety and health concerns brought to them were addressed in the Final Record of Decision issued in November, 1989, by the Undersecretary of the Army nor have they been subsequently resolved in writing; now therefore be it
>
> RESOLVED, That the American Medical Association continue the efforts of the Utah Medical Association to have the Department of Defense recognize and address the health and safety concerns which have been raised by the UMA and the Utah Department of Health concerning the DOD's Biological Defense Research Program [57].

Few programs of weapons research have drawn comparable public skepticism. The BDRP has generated criticism from diverse groups—congressional committees, government oversight agencies, Quakers, environmental organizations, the American Medical Association, thousands of independent scientists, and much of the state of Utah. The Army's trail of contradictory messages on the subject has fueled the disquiet. The psychopolitical consequence threatens further to undermine confidence by citizens in an institution that is supposed to protect them.

CONCLUSION

Recognizing the risks of the Army's biological program is not to minimize the need to protect U.S. military personnel. It is meant rather to face realistically the dangers and psychological and political costs of trying to achieve that end through the current BDRP. Some have suggested as an alternative that the program be transferred to the National Institutes of Health, the Centers for Disease Control, or other civilian agencies [28,58]. Doubtless vaccine research could be carried out as competently under civilian as under military auspices. At the same time, if biological agents are used to test detector systems and protective gear, close civilian oversight should be part of the protocol, which is not always the case now. These efforts should reduce the public suspicion that accompanies an exclusively military-run biological research program, and an improvement in the public mood would be welcome.

In the end, a fair appraisal of the risks of the present BDRP should be matched against its presumed benefits. As suggested earlier, the U.S. program has not deterred other countries from developing biological weapons. Moreover, there are many scenarios against which vaccines, detector systems, and cumbersome protective gear would be irrelevant. To suggest that a large population can be defended against a biological attack is an illusion. Army tests have demonstrated that biological agents may be effectively dispersed by a variety of surreptitious methods. Once released, the organisms might assume a niche in the environment that could threaten more people in greater areas and for a longer time than ever intended. Especially in the era of biotechnology, with the capacity to produce novel pathogens against which no vaccines or antidotes exist, the possibility of biological warfare takes on horrific dimensions.

The most rational defense against a biological attack, therefore, is prohibition. The key lies in strengthening the Biological Weapons Convention [59,60]. The treaty prohibits possession of biological and toxin agents, but it lacks provisions for verification of compliance or punishment of violators. In strengthening the treaty, and not in a BDRP, the search for protection can be most productive.

The U.S. doubts that the Convention can "be made effectively verifiable" and has chosen not to pursue aggressive efforts in that direction [25]. To minimize verification efforts seems precisely the wrong policy emphasis in view of the evidence that Iraq has developed a surreptitious biological weapons program. In addition to tightening the verification process, the punitive consequences of a treaty violation should be rendered more certain and severe.

As long as the United States maintains a Biological Defense Research Program, citizens are best served by understanding its risks and dangers. The Army's contention that the program is almost risk-free is inaccurate and threatens to generate further mistrust. Recognizing the dimensions of the actual situation better enables efforts to address potential problems. Understanding the true risk-benefit calculus of a military-biological program should encourage movement toward international agreements that would do away with such programs. ❧

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