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## Technology and Peace: The Role of Biological Research

Joshua Lederberg

### I. INTRODUCTION

My original assignment was to comment broadly on the subject of my title. To fulfill it properly, however, was beyond the scope of the allotted time and space. For a detailed analysis of the role of biological research on peace, I should have had to consider at least the following topics:

First, the evolution and biology of man as a foundation for personal and organized conflict, comprising the interrelationships among inherited instincts (and their diversity among individuals); the transmission and mutation of tradition from one generation to the next; the forms of global political organization; and the diagnosis and treatment of human failings from a biological, psychological, and sociocultural standpoint.

Second, the modernization of aspiring countries and peoples, including the improvement of crops, which has a strong base in biotechnology but so far has had only a minimal infusion of the most recent advances in molecular biology; the conservation of human capital, that is, public health, with particular emphasis on the impact of malnutrition on the development of intellectual and moral vigor; the development of the world's agricultural economy to the level of its industrial economy, with concern for the shocks of technological displacement (for example, what if a satisfactory, cheap synthetic substitute for coffee were discovered?); and improved techniques for controlling the rate of population growth within the capital resources of a country and within the carrying capacity of the earth.

Third, the protection of the global environment.

This inquiry is obviously too broad for proper treatment here. I have therefore refined my topic to the threat of biological warfare, which is undoubtedly the most fearful biological threat to peace.

The remarks in part II are presented substantially as delivered at the conference on November 18, 1969.<sup>1</sup> A few days later, they were (happily) mooted in some measure by President Nixon's announcement on November 25 unilaterally

renouncing U.S. capabilities for biological warfare.<sup>2</sup> In part III, I offer some current afterthoughts (as of April 1970) concerning further steps that have yet to be taken for the bolstering of biological science as an instrument of peaceful change and well-being.

## II. BIOLOGICAL WARFARE AND THE EXTINCTION OF MAN

I am grateful for this opportunity to express my profound concern about the continued involvement of this and other nations in the development of biological warfare. This process has put the very future of human life on earth in serious peril. It is all the more tragic because the great powers who should be hastening to institute international controls have little to gain and much to lose in relation to the present balance of nuclear deterrence. A serious side effect of biological warfare work by the major powers is the inevitable proliferation of a destabilizing strategic capacity for preemptive attack and for clandestine harassment.

Chemical warfare, though well demonstrated at a tactical level, is less important strategically, and is complicated by many technical details. Furthermore, it lacks the special hazard of contagion which makes biological warfare a unique peril to world peace.

Our ratification of the Geneva Protocol of 1925 would represent only the first small step toward the negotiation of international controls. However, so long as we have isolated ourselves as the only major power to refuse to enter this commitment, there is little chance for further negotiation. It leaves on record a low and unconvincing reading, indeed, of our earnestness as a nation in seeking world order for the management of this problem.

My own research career has centered on the genetics of bacteria. With Dr. E. L. Tatum, then at Yale, I had the thrill of discovering genetic recombination in bacteria. Later at the University of Wisconsin with my then graduate student Norton Zinder (like E. L. Tatum now a professor at Rockefeller University), I was privileged to help unearth genetic transduction (the use of viruses to convey information from cell to cell). I have also studied bacterial mutation, for example to resistance against the action of antibiotic drugs, in work that complemented the pioneering studies of Drs. S. E. Luria and Max Delbrück, who were named for the 1969 Nobel Prize in medicine.

Basic scientists who have worked in the genetics of bacteria and viruses believe that these discoveries have ever-growing importance for the prevention and healing of serious human diseases. In the present era, we live in incompletely justified optimism about having "conquered infectious bacterial disease" through the development of antibiotics. But viruses are, in general, still beyond the reach of antibiotic therapy. Even bacteria, believed to be under firm control with antibiotics, are evolving and continuing their assaults upon human

health with renewed vigor. In the long run, only our continued vigilance over bacterial evolution can justify our hope of maintaining a decisive lead in this life-and-death race.

Whatever pride I might wish to take in the eventual human benefits that may arise from my own research, however, is turned into ashes by the application of this kind of scientific insight to the engineering of biological warfare agents. We are in somewhat the same position as the nuclear physicists who foresaw the development of atomic weapons.

There is, however, a crucial difference. Nuclear weaponry depends on the most advanced industrial technology, and it has been monopolized by the great powers long enough to sustain a de facto balance of deterrence and to build a security system based on nonproliferation. Nuclear power has thus, ironically, become a stabilizing factor tending to reinforce the status quo parallel to established levels of economic and industrial development. Germ power will work just the other way.

The United Nations Study Report on chemical and biological weaponry has summarized some infectious agents that have served as points of departure for the development of biological weapons. Any knowledgeable virologist could suggest many more. I will not repeat these technical details, nor will I bludgeon you with the horrible diseases some of these agents provoke. I will also leave to your own conscience the burden of moral judgment about using these weapons. Most Americans would be repelled by the thought, but perhaps no less than by exposure to the human realities of any other form of warfare. Overriding such comparisons should be the grave moral issue of a policy that risks the lives of a world of innocent bystanders. Fortunately, these concerns actually converge with our self-interest in calling a halt to biological warfare before it becomes established in the arms traffic of the world.

My main fears about biological warfare have to do with the side effects of its proliferation: as a technique of aggression of small nations and insurgent groups, and the inadvertent spread of disease.

If the great powers could actually protect the secrecy of their biological warfare work I would be much less alarmed. The chance of biological warfare ever being used in a major strategic attack is essentially negligible in the face of the nuclear deterrent. The suggestion that we need biological or chemical warfare weapons for specific retaliatory purposes in order to deter their use aims at a ridiculous kind of precision. Will our deterrent missiles have to follow the same trajectories as those that might potentially attack us? Will they have to be launched at the same time of day? Will they have to have the same mix of explosive energy and radioactive fallout? If we are attacked with anthrax strain B27 must we reply with anthrax B27.

On the other hand, if I were a Machiavellian adviser to a would-be Hitler I might indeed advocate a considerable investment in biological weaponry as a

desperate approach to the cheap acquisition of great power even if at very great risk. And, of course, the first thing I would do would be to plant my intelligence agents in the existing biological warfare establishments of the high-budget powers in order to get the necessary scientific information at the lowest possible cost.

However, if I were patient I would not bother to do even that. No security system, no counterintelligence system in the world expects a delay of more than five to ten years in the leakage of vital information. We do not have, and I presume do not contemplate, a security reservation like wartime Los Alamos for the containment of biological warfare research. If a high level of activity is to be maintained there will be frequent turnover of personnel. It is unreasonable to expect a tighter security barrier here than has prevailed in any other area, given the problems of reconciling security with a free society. Besides these channels for diffusion of information, there are also bound to be *Pueblo*-like incidents, and calculated leaks in the budget competition of the services. The American people might be the last to know; but we can rely on hardly more than a ten-year delay between many important discoveries in biological warfare research laboratories and their availability to hostile and irresponsible forces outside.

As a matter of prudent self-protection, biological warfare research laboratories in the United States and the United Kingdom have pioneered in the technology of containing dangerous microbes. I have great respect for the technical capabilities of the senior civilian management of these laboratories. They should be credited with the utmost diligence in protecting both their personnel and the surrounding communities. They have also published a great deal of their work in the engineering of such protective facilities, and this experience is unquestionably of great value in public health work. For example, the British laboratories at Porton were acclaimed for the safe handling of the very dangerous Marburg virus upon its first outbreak in Europe two years ago.

In spite of these precautions, disease organisms have nevertheless escaped from time to time, and inevitably will do so in the future. Such escapes already constitute a breach of security. They also compromise public health, which is further threatened by keeping civilian physicians in ignorance of potential agents that might explode into large-scale epidemics. The intentional development of virulent strains resistant to conventional antibiotics obviously worsens the problem. We simply have no way of assuring that a biological warfare development will not eventually seed a catastrophic worldwide epidemic that ignores national boundaries.

On the immediate horizon are modern developments in molecular genetics. These undoubtedly point to the development of agents against which no reasonable defense can be mounted. Because of the uncertain danger of retroaction, such agents are hardly likely to be used as a result of any rational military

decision, but would obviously play into the hands of aggressive insurgence and blackmail. Finally, even the publication, albeit as a positive contribution to humanity, of the technology of safe containment insidiously helps solve a problem that might have hindered a potential insurgent from dabbling in biological warfare.

The problem of containing infectious agents being manufactured and stockpiled in large quantities, or tested in the open air, is a much more difficult technological challenge; and it is encumbered with even more official secrecy than the laboratory work. We have the Skull Valley incident to help judge the competence with which such matters might be handled. The main effect of security has not been to deny information to an enemy but to protect an establishment from both destructive and constructive criticism at home. In this case, more open constructive criticism would be crucial for assurance that procedures for containing microbes are well conceived and correctly implemented.

Biological warfare agents for use against man can be expected to be far more capricious than any other form of weapon. For any strategic purpose they are essentially untestable since large populations would have to be held to an uncertain risk. With nuclear weapons we can at least be confident of the laws of scaling. The destruction of targets can be calculated from simple physical measurements like the energy released. Nothing comparable to this can possibly apply to biological warfare agents. For this reason, again, the United States and other nuclear powers have absolutely nothing to lose in disavowing their use in war. Our continued participation in biological warfare development is akin to our arranging to make hydrogen bombs available at the supermarket.

Microbiological research must be expanded in programs of public health research for defense against our natural enemies. But the public health bureaucracy has refused to give prudent thought to the recurrence of major pandemics of human disease, be they of spontaneous or human-intelligent origin; perhaps this is simply a consequence of their sense of futility about mobilizing the necessary measure of global health needed to protect the species. If we add to already urgent concerns the spread of dangerous diseases from large foci of infection established by biological warfare attack, the prospects become even gloomier.

Our self-interest both as Americans and human beings urgently calls for the institution of improved measures of world public health and of international controls on the development and use of biological warfare agents. Research related to biological warfare should perhaps continue; but it is of the first importance that this be fear-reducing rather than fear-generating, for the latter can only lead to mutual escalation of antihuman developments.

It is difficult at this stage to detail the character of new agreements subsequent to our ratifications of the Geneva Protocol. We cannot suddenly impose unilateral decisions on the international community; but no other issue can

evoke such a unanimity of world opinion. New agreements probably should include (1) public legal commitments against secret biological warfare research; (2) the establishment of central, international laboratories to monitor the occurrence of threatening organisms and to help develop generally available means of protection against them; (3) a legal system to protect the freedom of information and communication of data on disease organisms to such central authorities; (4) a general acceleration of research and health services to minimize the incidence of infectious disease, particularly in underdeveloped countries. No situation could be better designed for the evolution of serious new viruses than the existence of crowded, underfed human populations in which foci could develop and spread with a minimum of medical control; (5) treaty commitments on biological warfare analogous to the nuclear nonproliferation treaty; (6) pre-agreed sanctions by the civilized world against the release or development of biological warfare agents, clearly invoking international law against such "offenses against mankind" as akin to war crimes.

Some of the possibilities I have outlined are speculations which I fervently hope will be proven false. Unfortunately, they already have a proven historical precedent. As many of you already know, the Black Death—the epidemic of bubonic plague in Europe between 1347 and 1350—was the immediate consequence of a primitive form of bacteriological warfare. Genoese colonists in the Crimea brought the plague back to Italy with them when they retreated from the fortress of Feodosiya after having been assaulted with the corpses of the attacking Tatar hordes who had been infested with the disease. This epidemic subsided only after killing approximately one third of the population of Europe, as well, presumably, as taking an equal toll in Asia and India. Unless we learn to apply our common energies against the common enemies of all mankind, we are foolish and arrogant to doubt that history will record Black Death II, and more.

### III. POSTSCRIPT (APRIL 1970)

President Nixon's announcement of November 25, 1969 (see Appendix I) was a major turning point in United States policy on biological warfare. At the very least it has relieved the prospect that American scientific ingenuity would be actively addressed to the development of these dangerous weapons. Until effective international agreements are negotiated and adopted, the danger remains that other countries will persevere in such development; however, most of their motive for doing so will have evaporated by virtue of our own abrogation. Furthermore, such countries have less highly developed scientific and technological expertise for basic innovations in microbiology, although they are well equipped to exploit advances that might be initiated here. These would inevitably "leak" in the course of time despite the most strenuous efforts to maintain their secrecy.

It is deplorable and discouraging that this unilateral step has not been followed by similar renunciations by Soviet bloc countries, which have voiced the loudest complaints about our own previous neglect of biological warfare issues.<sup>3</sup> In part this may be a bargaining move in an effort to push U.S. negotiators at the disarmament conferences into more comprehensive commitments than they have so far been able to agree to for want of reliable methods of verification. In part, this lack of response may also relate to the uncertainty of the exact meaning and intended implementation of the President's policy statement.

For example, suppose the Soviet Union were also to state that it would now "confine its biological research to defensive measures," if indeed it has not done so long since. Might we not assume that this language blanketed the same range of activities as prevailed beforehand? After all, no nation labels its military establishment as a Department of Offense!

In fact, the political realities of this country insure that Mr. Nixon's intentions go far beyond semantic games; and they may be expressed soon in such drastic measures as the piecemeal abandonment of the biological warfare research centers at Fort Detrick, and Pine Bluff, Arkansas. This is unfortunate, for these facilities are valuable resources in physical plant and in organized manpower for which other vital tasks are pressing. For example, Fort Detrick might be reclaimed as an *international* center for epidemic diseases, including biological warfare defense as one aspect of its open research program. The step-by-step implementation of Mr. Nixon's announcement will, I fear, dull most of the impact it could have on a suspicious world were its operational scope to be outlined in advance.

On the diplomatic front, the United States has joined the United Kingdom in proposals to deal with biological weapons promptly and separately from chemical weapons (see Appendix II). The technical arguments for distinguishing these are well stated by Ambassador Gerard Smith, and I would support this endeavor to complete a formal convention to abolish biological warfare as a first step. In effect, secrecy for any government research on agents of disease must (and ought to) be eliminated.

The problems of verification, even of definition, of a capability in chemical weaponry are much more serious. During the early stages of international rapprochement, unilateral initiatives (amounting to implicit negotiation) may be the most effective—a supposition that would be more plausible were there more evidence of a response to the first gambit on biological weapons.

It would help in the control of chemical warfare to organize a U.N. consultative group to identify toxic compounds with chemical warfare potential and devoid of peaceful uses. The U.N. group could then seek a registration of the compounds thus labeled and publish an accounting of their distribution. The United Nations should also provide technical facilities for the detection of chemical and biological warfare attack, and for the investigation of complaints



concerning incidents involving these weapons.

In the long run, it is the will of the great powers that will decide the further evolution of this issue. If peace and stability is their shared aim, the powers will discourage desperate experiments with these tools. If they are more preoccupied with stirring up trouble for each other, they will encourage chemical warfare capabilities within their spheres of influence. Is it to our interest, or to the Soviets', to forfend nuclear proliferation only to have it replaced by equi-lethal chemicals?