Joshua Lederberg

Biological Warfare: A Global Threat

Views

Will biomedical knowledge be dedicated to peaceful uses by international agreement or do we face a new weapons spiral?

"Germ warfare" has been universally condemned as a vile perversion of scientific insight. This emotional reaction is buttressed by a rational consideration of the strategic and political instabilities that would follow from threatened uses of biological weapons and of the possibilities of worldwide spread of infectious disease. In the interest of world order and to reduce the possibilities of igniting world conflict, the development, stockpiling, and general accommodation of biological weaponry must be controlled by international agreement.

The past twenty-five years, in the course of which the world community has reached a certain degree of familiarity with the problems of nuclear power and has undertaken some of the steps needed to contain it as a servant for rather than against human aims, have seen a sustained and remarkable development of molecular biology. For example, Professor Gobind Khorana recently reported the synthetic assembly of a small gene through chemical operations on DNA components. It will be a step of another order of magnitude to extend this technical capability to the synthesis of small viruses, but this surely will be accomplished within the next decade. This procedure will allow an unlimited range of experimental variations of the genetic structure of different viruses, a process which has many important potential applications for human health. It also offers us the prospect of engineering the design of viruses to exquisite detail. Accomplishments like Khorana's have been possible in a small laboratory on an annual research budget which is miniscule compared to weapons hardware.

For many years BW has been given only incidental attention as a subject of diplomatic discussion, for it seemed to have little bearing on the adjustments of power that were the main work of specialists in foreign affairs. However, BW does have something to do with efforts to reduce the barbarity of warfare. BW stands apart from all other devices in the actual threat that it poses to the health and life expectancy of every human being whether or not he is politically involved in belligerent actions. In a word, the intentional release of an infectious particle, be it a virus or bacterium, from the confines of the laboratory or of medical practice must be condemned as an irresponsible threat against the whole human community.

The Black Death

The Black Death, the great bubonic plague that ravaged Europe in the mid-fourteenth century, is in fact a well-documented historic example of just this process. The plague first entered Europe in 1346 via the sailors, rats, and fleas on the ships that returned to Genoa after having been expelled from Theodosia in the Crimea, where the attacking Tartars had catapulted some of their corpses into the Genoese fortifications. This plague, which reduced the population of Europe by at least one-third, would of course almost surely have made its way West sooner or later, the nature of the disease being quite beyond the comprehension of the medical science of that era.

The Black Death in Europe was only one of many visitations of the plague suffered by Europe during the last 2,000 years. We do not know why this one should have been so much more disastrous than many others. The progress of a disease in any given individual is subject to many factors, of which only a few are well understood. A large epidemic, involving millions of people spread over time and space, is an immensely more complicated phenomenon, about which it is very difficult to make accurate scientific predictions. This combination of a grave potential hazard with a high degree of unpredictability is a peculiar attribute of biological weaponry at its present stage of development, and it has a great deal to do with the rational doctrine that so far has placed a relatively low value on its military utility.

The present situation thus might provide the most favorable opportunity for international action to regulate the further development and proliferation of BW. I am convinced that we know enough about it to have legitimate concern about its future prospects. Until now no nation appears to have staked its security to any significant degree on BW armaments. I would therefore hope this provides a basis for accord. If we wait until BW has been developed into a reliable armament for use under a range of military doctrines, it could then be too late to disengage important powers from their commitment to it.

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The main barriers that may today keep bubonic plague from being a great threat in advanced countries are (1) understanding and use of quarantine, (2) the suppression of rats and fleas by general urban hygiene, and (3) the use of modern therapy, especially antibiotics, to control the disease. Each one of these barriers could be breached by further technical developments if a substantial effort were to be applied during the next decade to making the plague bacillus into a weapon.

Other infectious agents might be even more adaptable. Some of man's deadliest enemies are viruses which, like yellow fever, are transmitted by mosquitos or other arthropods. These have the advantage, from a military standpoint, that they may not start a potentially retroactive epidemic in areas where the vector insect does not normally abound. It is already evident that such insect-borne viruses could be applied in the first instance by direct aerial dissemination, with little or no further spread from the first wave of infected targets.

Recent reports of airborne or pneumonic rabies, a terrible disease, which is normally spread by the bite of an infected dog or other animal, illustrate this possibility. There is the danger that, if a large nucleus of people is attacked by insect-borne viruses, further evolution of the virus may give rise to a new form of the disease that does spread from person to person, contrary to the calculations of the attacker. The Black Death itself underwent a similar evolution from the original bubonic plague which was spread by fleas to outbreaks of the pneumonic variety which is far more contagious.

We have learned in recent years that viruses undergo constant evolution in their own natural history, not only by mutations within a given strain, but also by the natural cross-hybridization of viruses that superficially appear to be only remotely related to one another. Furthermore, many of us carry viruses in our body cells of which we are unaware for years and which may be harmless—though they may eventually cause the formation of a tumor, or of brain degeneration, or of other diseases. At least in the laboratory, we can show that such latent viruses can still cross-breed with other viruses to give rise to new forms.

Escalation of BW research

My gravest concern is that similar scientific breakthroughs of a rather predictable kind will be made and their potential military significance exploited, so as to result in a transformation of current doctrine about "unreliable" biological weapons. We are all familiar with the process of mutual escalation in which the defensive efforts of one side inevitably contribute to further technical developments on the other, and vice versa. The mere existence of such a contest produces a mutual stimulation of effort; moreover, there is no practical system of counterintelligence that will protect secret work for an indefinite period of time from becoming known to others. And the potential undoubtedly exists for the design and development of infective agents against which no credible defense is possible, through the genetic and chemical manipulation of these agents. It is thus clear to me that if we do not do something about this possibility, work will go forward and my fears will become realities.

For many years I have advocated that the control of biological warfare be given a special place in international and national initiatives, for reasons I have mentioned. I am deeply gratified that President Nixon's announcement (November 1969) which disavowed offensive biological warfare development has made it possible for me to address these issues in terms fully consistent with the policy of the government of my own country.

Man's natural enemies

Even after agreement to eliminate biological weapons, we will still remain very vulnerable to a form of biological warfare which is beyond the reach of any covenant that we can make. This is the warfare practiced upon us by nature, the unremitting barrage of infection by old and new agents that still constitute a very large part of the perils to normal and healthy life.

We have all had vexing, perhaps even tragic, personal experiences with virus infections. The global epidemic of influenza that was first identified in Hong Kong about three years ago was not a particularly severe form of the virus, and its eventual mortality was probably only in the tens of thousands. It is wrong, however, to believe that there is any assurance that the next epidemic of this kind will be as mild; and we have still developed only the most feeble and precarious protection against this threat whose impact is shared by all the nations but against which very little common defense has been erected.

From time to time small outbreaks of mysterious new diseases like "Lassa fever" and the "Marburg virus" have been in the news. These were both extremely dangerous threats; and while much credit must be given to the diligence of the medical people who dealt with the outbreaks, a large element of pure luck was involved in localizing these incidents. We must expect that there are many additional viruses already indigenous to primate and human populations in primitive areas, to which the inhabitants of advanced countries are extremely vulnerable.

Yellow fever is a historically important disease which now belongs in the same category. It is maintained on earth mainly through an animal reservoir of infection, in the monkeys in tropical jungles. Urban populations are now protected from yellow fever by campaigns to abolish the fever-carrying species of mosquitos in South America and by the availability of excellent vaccines in advanced countries. Mosquito species very well capable of transmitting yellow fever are, however, abundant in South Asia and the accidental introduction of yellow fever, for example, into India would be a human tragedy of catastrophic dimensions. Specialists in epidemiology are quite puzzled that this accident has not already happened; we have no satisfactory explanation for this good fortune.

I would not mention facts like these, which might stimulate psychotic imaginations, if they were not already well known. My purpose is not to suggest the vulnerability of the Asian continent to biological military attack but rather to point out immense gaps in the pattern of international cooperative defenses that should be mounted but that seem to have a low priority in the present-day world. This is in no way a derogation of the splendid efforts of the World Health Organization but an indication of the limitations of its budget and a suggestion that much more needs to be done and could be done with resources that

might be given over to biological work in the future.

Countries that are undergoing a transition in the development of their agriculture are vulnerable to analogous threats in biological warfare directed against crops as distinguished from human targets. The introduction of new crop varieties, which has had all the human benefits attached to the "green revolution," also means that the food supplies of vast territories are now committed to specialized strains of wheat, rice, and other basic crops. These are now newly vulnerable to destruction by plant pests of either natural or artificial origin. (The recent outbreak of corn blight in the U.S. was a costly confirmation of this outlook.)

Biological "peacefare"

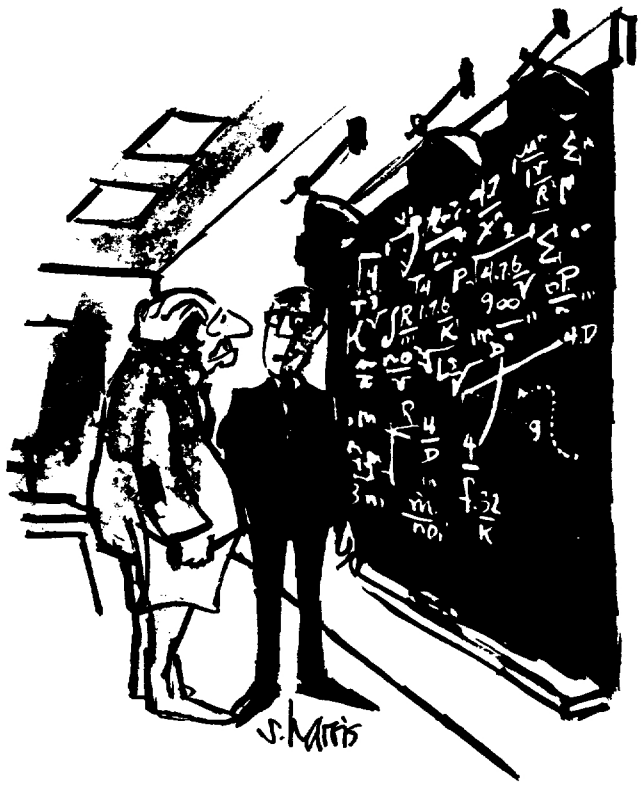
The promulgation of an international agreement to control biological warfare in a negative sense should, therefore, be accompanied by steps urgently needed to build positive efforts at international cooperation, a kind of defensive biological research against natural enemies of the human species. One of the best assurances any country might have that the microbiological research of its neighbors was directed toward human purposes would be constantly expanding participation in international health programs. Any country that publicly and avowedly subscribed to the total renunciation of secret BW research might conceivably continue clandestine efforts without revealing their *content*. There would, however, be great difficulty in maintaining such an effort, at any substantial level or quality of operation, while still keeping its very *existence* secret. It would soon be known by its own citizens who are specialists in health-oriented research and who are deeply involved in furthering health research activities within the framework of the international community. Therefore, besides the obvious direct health benefits of expanded international cooperation, we would also be rewarded by a higher level of mutual assurance that every party was indeed living up to the spirit of its obligations under a BW convention.

As the delegates to the Disarmament Conference are well aware, the United States' historic failure to ratify the Geneva protocol of 1925 was a major obstacle to international control of BW. At this writing, the issue is before the Senate Foreign Relations Committee. The Geneva protocol will undoubtedly be approved, though not before an embittered debate about the definition of *chemical* weapons (besides nerve gas, should this also mean tear gas? herbicides?), which present a whole range of problems distinct from those of BW. This question aside, the Geneva protocol is only a partial answer to international control, for it effectively constrains only the first use of a forbidden weapon. In fact, the U.S.S.R. has stressed that the threat of retaliation against a first use has been the main deterrent against lethal CW, e.g. the use of nerve gas by Hitler in World War II. However, this actually encourages investment in military technology for the testing, development, and stockpiling of more and more fearsome biological weapons in order to maintain such a deterrent.

The U.S. and the U.K. have proposed a specific ban on *all* aspects of BW in order to close this gap left by the Geneva protocol. The Soviet bloc counterproposes a comprehensive ban (but with no provision for international inspection or verification) on chemical as well as biological weapons. This approach is regarded by the Western bloc as an evasion of basic needs for security and likely to make more problems than it solves, for lack of a clear definition of a chemical weapon. This problem would be aggravated if non-lethal agents like tear gas or herbicides are designated as chemical weapons, since the domestic uses of such chemicals make nonsense of a prohibition against development and stockpiling.

Ecological warfare must be minimized to the extent that any controls on the conduct of war can minimize its ferocity; likewise we should seek all possible measures to dampen needless brutality, especially against civilians. To lump herbicides and tear gas with BW for these reasons imperils solutions to all of these problems.

Some of the speculations I have mentioned are ones that all of us must fervently hope will never materialize. But it would seem both foolish and arrogant to assume that our good will alone, without concrete arrangements, will serve to forestall the further development, proliferation, and possible eventual recourse to what surely is one of the most ghastly methods of warfare imaginable.



"It looks great, but why don't we put it on a punchcard so I can understand it."