

BOOKS

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Tomorrow's Weapons, Chemical and Biological. By JACQUARD HIRSHORN ROTHSCHILD. New York: McGraw Hill, 1964. Pp. 271 (includes maps). \$6.95.

Tomorrow's Weapons, by Brigadier General J. H. Rothschild, a retired commanding general of the now reorganized U.S. Chemical Corps Research and Development Command, aims to secure greater public approval for U.S. chemical and biological warfare (CBW) programs. General Rothschild retired from active duty in 1957. Since then, CBW expenditures have increased several fold. In 1961, the budget for Army expenditures for CBW research, development, and procurement was somewhat over 100 million dollars per year. Nonetheless, General Rothschild believes that more attention to CB weapons is required—not only to offset the capabilities of potential enemies, but also to enable U.S. forces to initiate the use of chemical and biological weapons under a wide variety of combat conditions.

There have been no recent official pronouncements on U.S. policy regarding the use of chemical and biological weapons. In 1943, President Roosevelt declared, "I state categorically that we shall under no circumstances resort to the use of such weapons unless they are first used by our enemies." However, the United States is not party to any treaty explicitly banning the use of CB weapons; in particular, the United States signed the 1925 Geneva Treaty prohibiting CB warfare but it was not ratified by the U.S. Senate. The Treaty is in force with respect to many nations including Great Britain, France, and the Soviet Union. In 1959, a resolution was introduced in the U.S. House of Representatives calling for

reaffirmation of the policy declared by President Roosevelt in 1943. The Departments of Defense and of State opposed the resolution and it was not adopted.

General Rothschild begins with a chapter intended to show that CB weapons would sometimes be more humane and, in any case, would not be more brutal than currently practiced forms of combat. As an example, he cites the savings in American and Japanese lives which might have resulted had mustard gas been used to capture enemy-held Pacific islands during World War II. The shortsightedness of this reasoning is typical of Rothschild's arguments for CB weapons. If gas had been introduced by either side in World War II, what would have been the probability of its use in Europe or in the Korean war or in some other conflict? And how many additional casualties, military and civilian, would then have resulted? These are difficult but obviously relevant questions. General Rothschild does not ask them. Instead, he argues for the introduction of CB weapons onto the world military scene with no consideration of the long-range consequences for the United States or the world in general.

Changes in the nature of weapons and warfare can profoundly influence the character and even the survival of societies. For this reason, the most careful and farsighted analysis should guide national policy concerning weapons with the radical potentials of chemical and especially biological agents. Unfortunately, to my knowledge, no such analysis has yet appeared. *Tomorrow's Weapons* does contain a considerable number of facts about CB weapons, but almost no attempt is made to weigh the serious issues they pose. Instead, much of the

text amounts to special pleading for this particular family of weapons.

The introduction of certain classes of toxic weapons into warfare poses a danger to U.S. security and to world peace which may be of overriding long-term importance. This danger, not considered by General Rothschild, concerns biological weapons. If the technical problems associated with the effective dissemination of biological agents could be solved, enormous destructive capability could become available at radically low cost, since the amounts of agent potentially sufficient to attack great areas are incredibly small. The introduction of radically cheap weapons of mass destruction into the arsenals of the world would not act as much to strengthen the big powers as it would to endow dozens of relatively weak countries with great destructive capability. Such weapons could even come within the reach of dissident private groups and individuals. It is obviously to the advantage of great powers to keep war very expensive.

Fortunately, there are likely to exist substantial barriers to the perfection of effective biological weapons. Research and development entail considerable cost and technical sophistication. The proper testing of biological weapons would require large-scale efforts, including use on humans—either safeguarded volunteers or enemy personnel during wartime. But once this development is accomplished by any nation, the technology would almost certainly diffuse to others, in spite of security precautions. Great powers, in their own security interests, should take strong measures to prevent the introduction of biological weapons into warfare. The orientation of research, development, and doctrine should be kept strictly defensive.

Behind most discussions of the brutality of toxic warfare lies a very widespread concern with its moral implications. Why is this? What consideration can be given to moral factors in the conduct of war—society's least moral activity? Widespread restraints against certain forms of human combat may be partly based on instinct and accordingly may be wiser than we know. I realize that considerations of this sort are subject to easy criticism, but it may nevertheless be immensely important to read correctly the popular attitude which holds the use of chemical and

biological weapons to be cowardly and inhuman. Nations have continually searched for more powerful weapons with which to offset the power of others. In the course of this development, governments and peoples have come to countenance ever increasing levels of destruction in the pursuit of national objectives. At some point this process must be arrested and then reversed if civilization is to overcome the threat to its existence posed by the application of science to warfare. Both tacit and formal international arrangements for maintaining peace are required. But, for long-term stability, there will also be required the growth among men of a powerful disinclination for organized violence. It would be a backwards step to extend the varieties of violence which we now tolerate to include such hitherto reviled means as chemical and biological warfare.

The final chapter of *Tomorrow's Weapons* comes as something of a surprise. In it, General Rothschild advocates a world government which would replace national deterrence and arms control with comprehensive measures for the elimination of war. He proposes rapid and inspected disarmament of all nations down to force levels sufficient to keep internal order. An international court with various safeguards against tyranny would maintain a police force superior to that of any combination of nations. Nonlethal toxic agents would be the weapons of choice for the peacekeeping force. Rothschild considers that although the development of formidable and easily produced biological weapons would complicate inspection for disarmament, the invincible police force would make cheating unprofitable and therefore unlikely. But certainly it would be wiser not to bring such weapons into existence and acceptance in the first place.

At the end of World War II spending on such chemical-biological warfare research ran only \$8 million a year. . . . Beginning about 1960, . . . spending began to rise significantly, to nearly \$50 million. In the fiscal year ended last June [1963], the figure topped \$100 million and this year [1963-64] \$114.5 million is allocated.

—William Beecher, in the *Wall Street Journal*, August 16, 1963.



LETTERS

DNA

I would like to question a concept discussed by Professor H. J. Muller in the January *Bulletin*. At issue is the idea that DNA is a self-replicating molecule and that, thereby, it contains in itself the main features of life. I do not mean to argue against the rather loose use of the term self-replication as meaning that DNA contains the necessary information which, in the presence of the appropriate enzymes and substrates, controls the nucleotide sequence of a complementary daughter DNA chain. My opposition is to the argument that this property constitutes self-replication in the sense that organisms or cells are able to replicate themselves. Of course, the property of self-replication is not an absolute one, even autotrophs require water, minerals, carbon dioxide, and sunlight, whereas other organisms may require forty or more specific organic compounds in addition. Whatever the requirements, however, they are very simple when compared to the complexity of the organisms which can replicate themselves in their presence. Organisms can reproduce their own constituents, including thousands of proteins, a variety of nucleic acids, and a host of smaller compounds, from a handful of simple environmental ingredients.

DNA has no such properties. For the replication of DNA there are three main requirements. One is DNA itself, a second is the appropriate amount of deoxyribonucleotides, the third is the presence of the appropriate enzymes. Muller implies that the third requirement may not be obligatory when he says, ". . . the construction (by Kornberg, Ochoa, and others) of chains of nucleotides capable

of replicating themselves in a test tube (even though only with the help of an enzyme as yet) . . ." and "What are the dynamics of replication or near replication in its varied forms (including the production of RNA from DNA), and under what circumstances can it occur without the aid of enzymes?" I know of no evidence that DNA can replicate itself in the absence of enzymes, nor does it seem likely, from the known properties of DNA, that any such evidence will be forthcoming. For this to take place DNA must have the property of lowering the activation energy of formation of sugar phosphate bonds between nucleotides. This is not a property which has been, or seems likely to be, observed by DNA. If enzymes are required, DNA is not self-replicating since DNA cannot produce enzymes. It does, apparently, contribute necessary information for synthesis of proteins, but this information is transferred through RNA to a preexisting complex system containing enzymes, all of which is necessary for the production of enzymes. So that, among other things, both enzymes and DNA are required for the synthesis of enzymes just as they are both required for replication of DNA. Finally, DNA is unable to synthesize the desoxynucleosidetriphosphates necessary for its replication. These compounds are synthesized from simpler precursors by a number of complex series of enzymatic reactions. DNA plays a role indirectly, in that it provides information for the synthesis of enzymes, but has no direct role in the synthesis of the nucleotides.

The strides that have been made in recent years, relating DNA to the transmission of hereditary characteristics, are a great accomplishment of