MAR 26 1971

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# FUTURE PROSPECTS IN BW

I hesitate to pursue this topic for fear of persuading our own DOD (and others') that the technology must be pursued. There is little doubt that BW could eventually transform the style of tactical warfare (and ultimately strategic also) in the same fashion that nuclear energy has done.

There is one basic argument against the techno-humanitarian*. The fundamental defenses will be physical enclosures or barriers, and it will be so "efficient" to combine physical disruption (firepower) to assure penetration of BW that I can see no possibility of humaner war in the actual practice of conflict.

Why BW is a special issue

The ultimate argument that distinguishes BW from all other weapons is the odds of pandemic as a global side-effect of BW attacks and their escalation. Connected to this is the growing sophistication of molecular biology (including virology) and the need to maintain a species-wide policy about the utilization of new knowledge. That is, some new discoveries may be inherently very beneficial or very dangerous, whether intentionally promoted for military purposes or not; and we must sustain a world order to regulate their application. This will be impossible if secret military work continues in the biological sphere (or is resumed if the present semi-moratorium fails).

Military credibility of BW

In fact, military developments in BW (if rationally designed) will not center on the horrors of doomsday weapons, e.g. on developing BW agents "against which no defense is possible." Present BW agents are already sufficiently terrible, or could reality be improved to meet any standard of horror. But these are militarily useless because of the problems of safe handling, of controlling spread and retroaction and long-lasting contamination. "Ultimate BW" will not be the direct outcome of rational military research, but may be a side effect

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*view that B (and C)W should be promoted as a way of accomplishing military goals with less violence than presently used.

of the escalation of BW work in other spheres.

This will then center on the solutions of the practical problems that hinder present BW doctrine. — BINARY BW — For example, the development of the binary CW shell is far more likely to stimulate the proliferation of CW capability (and eventual use) than would the discovery of a new nerve gas that was ten times more potent. (The latter type of development would interact with the binary technology in an obvious way; but more likely, a focus on binaries will re-orient the search for agents to uncover those which function most efficaciously in the context of the whole binary system: including such factors as stability and commercial availability of precursors, efficiency (and insensitivity to environmental variables) of the reaction, ease of disposal, and even camouflage of peaceful uses to avoid international detection.

Similar developments can be anticipated in the BW field. There is even a laboratory precedent for a biological binary (1) where two infections separately harmless are devastating in combination, or (2) where a bacterial virus modifies a bacterium to make the latter toxic.

This concept could support the following scenario. Let X + Y be the two interacting agents. In country A a pandemic of X is intentionally seeded. It will have a mild effect by itself, and by the time it spreads to country B, the citizens of A have recovered and are immune. At that point, A attacks B with virus Y plus additional doses of X.

A is self-protected by its immunity to X. In general, the spread of a binary combination will be less rapid than of a single agent.

This concept would have many other potential variants. For example, certain intestinal organisms occur very commonly in some parts of the world in distinction to others. In a sense, such populations are already infected with the analogue of the X of the previous paragraph and would, therefore, be especially vulnerable to Y. Conversely, as we know from our experience with traveler's diarrhea, local populations are often already immune to agents that can have serious consequences for inexperienced targets. We have many examples today which are much more serious than the traveler's disease - for example, measles, smallpox, and polio, and there is no doubt that this principle could be used in such a way as to allow considerable specificity in biological attack.

Then we have the potential exploitation of differences in the prevelance of vectors of infection, like the mosquitœs that can transmit yellow fever. South Asia is especially vulnerable in this respect.

Specificity by immunization

The concept of specific immunization of the attacker population has often been discussed, but if this is done in an overt fashion it will, of course, distroy the secrecy of any preparations. This would not necessarily be a final obstruction to the use of BW in a situation where hostilities were already in progress. This option, however, illustrates how difficult it is to disstinguish between defensive and offensive developments. If I were charged with managing such programs I would give considerable attention to the development of methods for the covert immunization of the home population. This does not have to be done with specific inoculations since viruses can be developed which are contagious, confer immunity, but have low disease-producing capacity.

Non contagious primary infection

Diseases can also be developed, and indeed have been, which do not result in a continued chain of infection. This is illustrated by the dissemination of "arbor-viruses" by aerosols in place of their customary insect vectors. This would allow considerable specificity since the disease would simply not spread in the absence of the appropriate vector. It is even a very plausible speculation that mutant

viruses can be developed (from the existing insect-born diseases) which are simply not spread at all by any existing insect species. The infected agents would be produced in bulk in artificial conditions, could initiate an infection in the target population, but would be so designed that they would not spread further from the infected individuals.

Environmental and genetic specificity

Specificity can also be contemplated by interactions with environmental factors, such as climate, or the nutritional status of the target population (which may go either way - some diseases will progress most rapidly in a well-fed target), or even specific dietary factors. The appropriate example does not now exist, but it is easy to imagine a virus that would be blocked by wheat protein in distinction to rice, or vice versa. Finally, we have the credible spector of the exploitation of genetic, (that is racial) differences between populations as the basis of infective specificity.

Latent period

One of the important arguments against the tactical use of biologicals is the latent period between the attack and the appearance of disabling symptoms. (It should also be stressed that disability is probably to be favored over mortality in most tactical uses of these weapons) Where diseases are disseminated by sabotage or where hostilities between major groups are chronic, these limitations are less pertinent.

— Toxins —

At the tactical level it is difficult to forsee how the latent period could be appreciably shortened, if we think of a BW as relying upon the penetration of a small number of infectious particles. On the other hand, if biological weapons are used in a way that does not require extensive multiplication in the host, the issues then merge into those that relate to chemical weaponry. Toxins then loom very large as the prefered agents. One important advantage is their very high potency, at present about 1000-fold greater than nerve gas. They are probably susceptible to considerable further refinement in potency by a factor of perhaps 10-100. But much more important than these considerations is that, in theory, they lend

themselves to the same development of immunity and of specificity as mentioned for the BW gamut. Toxins, although undoubtedly chemicals, have been operationally linked to BW for arms control purposes. If restraints on BW are not sustained, toxins would undoubtedly receive a great deal attention. Repeat: all of the facilities, including safe-handling, the binary concept, and the rest that were mentioned for BW would be applicable to these compounds.

Toxins are on the verge of being synthesized by chemical procedures in the laboratory. The control of that threshhold is an important consideration in timely arms control on BW generally.

Toxins can undoubtedly be engineered so as to have progressively shorter latent periods.

anti crop agents

BW applied against crops offers another avenue for uses which may entail little risk of retroaction and in some circumstances limited risk of spread outside the strategic target area. Besides, all of the potentialities for precision mentioned previously, the species- and strain-specificity of agricultural crops gives one more handle. Our contemporary experience with the cornblight fungus illustrates this all too well. Insofar as the modernization of agriculture is often associated with concentrated use of specialized crop varieties it also leads to increased vulnerability to this form of biological attack. It should be remembered that some plant species have been completely wiped out by disease (like the American chestnut).