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U.S. CHEMICAL WARFARE POLICY

HEARINGS

BEFORE THE

SUBCOMMITTEE ON NATIONAL SECURITY POLICY AND SCIENTIFIC DEVELOPMENTS

OF THE

COMMITTEE ON FOREIGN AFFAIRS HOUSE OF REPRESENTATIVES

NINETY-THIRD CONGRESS

SECOND SESSION

MAY 1, 2, 7, 9, AND 14, 1974

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INTRODUCTION

In November 1969 the Subcommittee on National Security Policy and Scientific Developments held extensive hearings on the subject of U.S. policies on and international effects of chemical-biological warfare. Since that time little if any concentrated attention has been devoted to the issue.

While several encouraging developments have occurred in the ensuing years, the period has also been marked by inaction and stalemate in other crucial CW areas. Thus, it seemed appropriate for the subcommittee to conduct a thorough review of the issues in an attempt to gain new insight and perspective on the complex and challenging question of chemical warfare.

Forming the legislative basis of the subcommittee's inquiry were a number of similar and identical resolutions sponsored or cosponsored by some 46 Members of Congress. Basically, they called on the President and the Congress to resolve the U.S. position on the future status of herbicides and tear gas so that the Senate could move forward toward immediate ratification of the 1925 Geneva protocol. The resolutions also provided that reconsideration of the protocol would in turn afford an opportunity for a comprehensive review of U.S. chemical warfare policies, with some specific reference to the proposed binary nerve gas proposal.

In its efforts the subcommittee was fortunate to have the cooperation of a distinguished group of witnesses, including Members of Congress, private experts, representatives of interested professional organizations, and spokesmen for the Departments of State and Defense and the Arms Control and Disarmament Agency.

Their testimony provides a significant body of information and opinion on chemical warfare. In an effort to formulate as comprehensive a record as possible, an appendix of related documents also has been included.

This volume is being released now because of its timely relevance to the anticipated renewed discussion of Senate ratification of the protocol, the current debate on the binary issue, and related issues such as the ongoing negotiations at Conference of the Committee on Disarmament in Geneva.

Following further review of the information received during the hearing, the subcommittee intends in the near future to report legislation to the full Foreign Affairs Committee and to release a report of its analysis, findings, and recommendations.

CLEMENT J. ZABLOCKI,
Chairman, Subcommittee on National Security Policy and Scientific Developments.

JUNE 6, 1974.

U.S. CHEMICAL WARFARE POLICY

WEDNESDAY, MAY 1, 1974

House of Representatives,
Committee on Foreign Affairs,
Subcommittee on National Security
Policy and Scientific Developments,
Washington, D.C.

The subcommittee met at 10:40 a.m. in room 2172, Rayburn House Office Building, Hon. Clement J. Zablocki (chairman) presiding.

Mr. Zablocki. The subcommittee will please come to order.

The subcommittee today opens very important hearings on U.S. chemical warfare policy. More specifically, we have under consideration a number of similar and identical resolutions sponsored or cosponsored by some 46 Members of Congress* calling on the President and the Congress to resolve the U.S. position on the future status of herbicides and tear gas so that the Senate may move forward toward immediate ratification of the 1925 Geneva protocol. The resolutions also provide that reconsideration of the protocol would in turn provide an opportunity for a comprehensive review of U.S. chemical warfare policies.

Today we are privileged to hear testimony from Members of Congress who have a special interest in this important subject.

Our first witness is the Honorable Gaylord Nelson, a leading authority in the Senate on chemical warfare and a distinguished colleague and fellow Wisconsinite. We are proud to welcome you, Senator. If you will proceed, sir.

I would like to state in view of a Democratic caucus we have had a problem, Senator, in getting Members here on time. I hope you will accept our apology.

STATEMENT OF HON. GAYLORD NELSON, A U.S. SENATOR FROM THE STATE OF WISCONSIN

Senator Nelson. Thank you, Mr. Chairman.

URGES RATIFICATION OF GENEVA PROTOCOL

I appreciate the opportunity to come here this morning. I want to commend the chairman of the committee for undertaking this com-

*List of sponsors and cosponsors for resolutions on chemical warfare policy:
H. Res. 679, 712, 713, and 752: Introduced by Representative Owens. Cosponsored by Representatives Reuss, Abzug, Ashley, Bingham, Brown of California, Chisholm, Conyers, Dellums, de Lugo, Edwards of California, Green of Pennsylvania, Harrington, Hechler of West Virginia, Helstoski, Holtzman, Leggett, McCloskey, McDade, McKay, Mezvinsky, Moakley, Mosher, Moss, Obey, Aspin, Podell, Rees, Riegle, Rosenthal, Roybal, Seiberling, Stark, Studds, Thompson of New Jersey, Tiernan, Udall, Ullman, Burke of California, Corman, Hamilton, Koch, Kyros, Rangel, and Fraser.
H. Res. 710: Introduced by Representative Dellenback.

prehensive hearing and evaluation of the issue of the use of chemicals in warfare. Regrettably it is still necessary to review this issue even 4 years after the Senate Foreign Relations Committee completed its hearings on the 1925 Geneva Protocol Ban on Chemical and Biological Warfare.

When the President submitted the Geneva protocol to the Congress for ratification he specifically excluded herbicides from his interpretation of the Geneva ban. Chairman Fulbright of the Senate Foreign Relations Committee sent a letter, dated April 15, 1971, to the President advising him that the committee's position was that the protocol does include a ban on herbicides; that is, that that was the interpretation of the committee. That position is embodied in Executive Understanding No. 1, which I introduced on January 29, 1971.

I might say at this point, Mr. Chairman and members of the committee, I would ask to be able to submit the testimony in full for printing in the record and that I condense the testimony a bit since I am needed in the Interior Committee of the Senate in a markup session on an important bill.

Mr. ZABLOCKI. Without objection, the prepared and complete statement will be made a part of the record following your oral summary.

You may proceed, Senator Nelson.

Senator NELSON. Now that interpretation has been under review for nearly 3 years. I think the Geneva protocol interpretation has been considered long enough and that we ought to get a final resolution of this matter with the administration's interpretation concerning herbicides at an early date.

The need to reexamine the status of the 1925 protocol is, I think, urgent. We in the United States have courted international opprobrium long enough, and we have backed ourselves into a corner with a tiny minority of countries voting against the great majority of the United Nations countries in the General Assembly, which agreed in 1969 on a resolution stating that the military use of herbicides was within the purview of the Geneva protocol.

I neglected to check the vote on that. I think it was something like 80 to 3, with the United States the only major country dissenting from the interpretation that herbicides be covered by the Geneva protocol.

NO REASON TO SUPPORT HERBICIDES

American soldiers are now out of Vietnam, and no longer is there any reason for continued support of herbicides as a military weapon, if in fact there was any sound military reason for it in the first place, which I doubt.

In fact, the mere notion that herbicides were useful weapons of war in Southeast Asia has become increasingly doubtful. A series of studies in the aftermath of the Vietnam war have thrown cold water on the thesis that herbicides are effective military agents.

A Department of the Army study entitled "Herbicides and Military Operations" lists only two situations in which herbicides might have been useful—to increase limited visibility and to destroy crops. The Army study damned herbicides with the concluding faint praise:

> Herbicides can be useful as a support to military operations provided that special circumstances exist.

I can find no really convincing evidence that in fact it is a useful military weapon.

The study provides little tangible evidence of these "special circumstances", or that they did in fact exist in Vietnam to an extent which can justify the far more extensive counterproductive ecological, sociological and psychological effects on the Vietnamese which are discussed in another study by the National Academy of Sciences.

EFFECTS OF HERBICIDE USE IN VIETNAM

The recently released NAS herbicide study,* which was contracted by the Department of Defense, revealed that herbicides extensively damaged Vietnam's inland tropical forests, destroyed 36 percent of the mangroves along the South Vietnam coast, may have caused deaths among Montagnard children, and caused many Vietnamese to view the United States as its enemy because Americans destroyed their crop lands and forests, which are so critically important to the economy.

In my view, this study fully supports the scientific estimates of the Herbicide Study Group of the American Association for the Advancement of Science, which reported in the late 1960's of widespread ecological damage to certain regions of Vietnam. We now have unequivocable evidence that the mangrove forests, for example, have been damaged to such an extent that without considerable reforestation efforts, it may be decades, if ever, before these important ecosystems will recover from that damage.

DAMAGE TO SOIL AND WATER

More studies are required to definitely state the effects on human beings from the extensive use of herbicides in Vietnam. New, sophisticated techniques of analysis, however, are demonstrating that the dioxin contaminants of Agent Orange, the military compound consisting of herbicides 2,4,5–T and 2,4–D, persist in the soil and water of Vietnam and have even entered the food chain.

The damage done eventually involved an area of destruction the size of the State of Massachusetts. As you know, finally the Pentagon abandoned its defoliation program after many expressions of concern within the Congress and within the country.

We incidentally have used 2,4,5–T in this country for purposes of restoration of croplands, and serious issues have been raised about the residual effect of introducing dioxin into the food chain and into the environment. Dioxin, as you know, is the most toxic synthetic agent known to man. Next to botulinum toxin, dioxin is the world's most toxic agent. It is present in 2,4,5–T in only very, very small amounts, but it is dangerous in only very, very small amounts. Furthermore, we do not know what occurs, if anything, in the biological magnification in the food chain.

DIOXIN

The Environmental Protection Agency is presently completing a major health and environmental monitoring program aimed directly at the dioxin contaminant in 2,4,5–T. Extensive hearings by the EPA

*A summary of the National Academy of Sciences study on the use of herbicides in South Vietnam appears in the appendix on p. 251.

are scheduled to begin this month to determine whether any agricultural use in this country of 2,4,5–T should continue.

EPA is not the only agency concerned about this potent compound which was dumped so indiscriminately on the Vietnamese landscape. The Food and Drug Administration has included 2,4,5–T as one of its priority substances which the Toxicological Research Center in Pine Bluff, Ark., is studying to determine low dose, chronic teratogenic, mutagenic, and carcinogenic effects.

If the U.S. Government persists in excluding this kind of dangerous chemical from its interpretation of the Geneva protocol, we can be certain that the world will place little credence in America's ratification of this treaty. How can we expect any other reaction from any other nations of the world? Chemical warfare agents are designed to be toxic. Certainly everything we have learned about 2,4,5–T indicates that it should be classified as a toxic agent and included within the scope of the protocol ban.

EFFECT OF BINARY PROGRAM ON GENEVA NEGOTIATION

The issue of excluding herbicides is not limited only to the 1925 Geneva protocol. For the past 2 years, U.S. negotiators have been engaged in discussions at Geneva on an expanded chemical warfare treaty which would go beyond banning chemical warfare and involve itself in restricting research, development, testing, and stockpiling chemical munitions. Thus far, the United States has devoted considerable discussion to the definitions of compounds such as herbicides which should be excluded from the definitions of chemical weapons. Some observers view this American semantic exercise at Geneva as a stalling tactic.

It seems to me that this same problem is true for the current Army proposal to begin the production of binary (nerve gas) chemical weapons. The binary nerve gas system consists of two chemical agents which, when kept separate, are relatively harmless, but when combined, such as in an artillery shell after it has been fired, produce a lethal nerve gas.

At a time when we might make some progress in chemical arms control negotiations, we have a proposal from the Army to begin what will certainly and ultimately be a massive reconstruction and modernization of our chemical weapons stockpile. I wonder if the risks which accompany this proposal in terms of potential proliferation of chemical weapons have been fully evaluated by the Department of Defense compared to the estimated risk associated with the status quo pending the outcome of treaty negotiations.

Mr. Chairman, I would conclude here. That covers the essence of what I had to say, particularly about the herbicides, and not impose further upon the time of the committee.

I thank you very much.

[Senator Nelson's prepared statement follows:]

PREPARED STATEMENT OF HON. GAYLORD NELSON, A U.S. SENATOR FROM THE STATE OF WISCONSIN

Mr. Chairman, I appreciate this opportunity to join with the House Foreign Affairs Committee in its efforts to examine the very important issue of U.S. chemical warfare policies.

Regrettably, it is still necessary to review this issue four years after the Senate Foreign Relations Committee completed its hearings on the 1925 Geneva Protocol ban on Chemical and Biological Warfare.

When the President submitted the Geneva Protocol to the Congress for ratification, he specifically excluded herbicides from his interpretation of the Geneva Ban.

Chairman Fulbright of the Senate Foreign Relations Committee sent a letter dated April 15, 1971, to the President advising him of the Committee's position that the Protocol included a ban on herbicides. That position is embodied in Executive Understanding No. 1, which I introduced on January 29, 1971.

The Administration has had its controversial interpretation of the Protocol "under review" now for nearly four years. To this day, the Foreign Relations Committee has not received an Administration response.

The Administration, in my opinion, has delayed long enough on the deadly serious question of chemical warfare. The need to re-examine the status of the 1925 Protocol is urgent. We in the United States have courted international opprobrium long enough. We have backed ourselves into a corner with a tiny minority of countries voting against the great majority of the United Nations General Assembly which agreed in 1969 on a resolution stating that the military use of herbicides was within the purview of the Geneva Protocol.

American soldiers are out of Vietnam. No longer is there an excuse for the Administration's continued support of herbicides as military weapons.

In fact, the mere notion that herbicides were useful weapons of war in Southeast Asia has become increasingly doubtful. A series of studies in the aftermath of the Vietnam War have thrown cold water on the thesis that herbicides are effective military agents.

A Department of the Army study entitled "Herbicides and Military Operations" lists only two situations in which herbicides might have been useful—to increase limited visibility and to destroy crops. The Army study damned herbicides with the concluding faint praise: "Herbicides can be useful as a support to military operations provided that special circumstances exist." The study provides little tangible evidence that these "special circumstances" did in fact exist in Vietnam to an extent which can justify the far more extensive counterproductive ecological, sociological, and psychological effects on the Vietnamese which are discussed in another study by the National Academy of Sciences.

The recently released NAS study, which was contracted for by the Department of Defense, revealed that herbicides extensively damaged Vietnam's inland tropical forests, destroyed 36 percent of the mangroves along South Vietnam's coasts, may have caused deaths among Montagnard children, and caused many Vietnamese to view the United States as its enemy because Americans destroyed their croplands and forests, which are important to the economy.

In my view, this study fully supports the scientific estimates of the Herbicide Study Group of the American Association for the Advancement of Science which reported in the late 1960's of widespread ecological damage to certain regions of Vietnam. We now have unequivocable evidence that the mangrove forests, for example, have been damaged to such an extent that without considerable reforestation efforts, it may be many decades, if ever, before these important ecosystems will recover.

More studies are required to definitely state the effects on human beings from the extensive use of herbicides in Vietnam. New, sophisticated techniques of analysis, however, are demonstrating that the dioxin contaminants of Agent Orange, the military compound consisting of herbicides 2, 4, 5–T and 2, 4–D, persist in the soil and water of Vietnam and have even entered the food chain.

As you know, the issue of the environmental effects of herbicides has troubled me for a long time. I used every legislative device at my command to require the prohibition of the use of herbicides in the Vietnam War. And eventually in 1970—after an area the size of Massachusetts had been sprayed—the Pentagon abandoned its defoliation program in Vietnam.

In this Country, I have fought to restrict the use of 2, 4, 5–T for agricultural purposes pending any conclusive scientific evidence that the chemical is safe. Compelling evidence suggests that it is indeed not safe, since it is highly probable that certain toxic trace elements—namely dioxin—which is present in 2, 4, 5–T may accumulate in the food chain and present a potential danger to human beings.

Dioxin is the most toxic synthetic agent known. Next to botulinum toxin, dioxin is the world's most toxic agent. It is present in 2, 4, 5–T in only very, very small amounts, but it is dangerous in only very, very small amounts.

The Environmental Protection Agency is presently completing a major health and environmental monitoring program in this country aimed directly at the dioxin contaminant in 2, 4, 5–T. Extensive hearings by EPA are scheduled to begin this month to determine whether any agricultural use of 2, 4, 5–T should continue.

EPA is not the only agency concerned about this potent compound which was dumped so indiscriminately on the Vietnamese landscape. The Food and Drug Administration has included 2, 4, 5–T as one of its priority substances which the Toxicological Research Center in Pine Bluff, Ark., is studying to determine low dose, teratogenic, mutagenic, and carcinogenic effects.

If the U.S. Government persists in excluding this kind of dangerous chemical from its interpretation of the Geneva Protocol, we can be certain that the world will place little credence in America's ratification of this treaty. How can we expect any other reaction from the other nations of the world? Chemical warfare agents are designed to be toxic. Certainly, everything we have learned about 2, 4, 5–T indicates to me that it should be classified as a toxic agent and included within the scope of the Protocol ban.

The issue of excluding herbicides is not limited only to the 1925 Geneva Protocol. For the past 2 years, U.S. negotiators have been engaged in discussions at Geneva on an expanded chemical warfare treaty which would go beyond banning chemical warfare and involve itself in restricting research, development, testing, and stockpiling chemical munitions. Thus far, the U.S. has devoted considerable discussion to the definitions of compounds such as herbicides which should be excluded from the definitions of chemical weapons. Some observers view this American semantic exercise at Geneva as a stalling tactic.

The question is whether the Administration is serious in wanting to establish and enter into a meaningful chemical warfare arms control treaty. Our representatives to this conference have indicated in general terms a desire to conduct such negotiations but they have nevertheless procrastinated in their actions. It seems that this matter is not receiving the necessary priority attention from the White House and that our negotiators, in the absence of more direct and specific guidance, have been forced into the delaying tactic of detailed and agonizing deliberations on definitions and elaborate discussion of chemical warfare terminology. Our representatives have yet to complete and present to the Conference a proposal which would indicate what would be considered an acceptable treaty. The issue of verification of compliance with a chemical warfare treaty is critical. However, I wonder what priority the Administration has placed upon evaluation of the alternative risks associated with the questionable military usefulness of herbicides as compared to the existence of a majority world opinion which classifies herbicides as chemical warfare agents.

BINARIES

It seems to me that this same problem is true for the current Army proposal to begin the production of binary (nerve gas) chemical weapons. The binary nerve gas system consists of two chemical agents, which, when kept separate, are relatively harmless but when combined, such as in an artillery shell after it has been fired, produce a lethal nerve gas.

At the very time when we might make some progress in chemical arms control negotiations, we have a proposal from the Army to begin what will certainly and ultimately be a massive reconstruction and modernization of our chemical weapons stockpile. I wonder if the risks which accompany this proposal in terms of potential proliferation of chemical weapons have been fully evaluated by the Department of Defense compared to the estimated risk associated with the status quo pending the outcome of treaty negotiations.

In my view, we risk nothing by including herbicides within the purview of the Geneva Protocol and we increase the credibility of our intention to comply with the treaty. We risk nothing by delaying the modernization of our chemical warfare stocks and if we decide to procure a binary system we may destroy the gains which we hope will accompany the ratification of the Geneva Protocol and the progress of current negotiations at Geneva on arms control of chemical research, development, and stockpiling.

The Army appropriation proposal to develop and procure a binary system, the National Academy of Sciences study which demonstrates the vast ecological damage in Vietnam from herbicides, the Biological Convention which this Nation has signed but not yet ratified, the on-going Geneva Negotiations on chemical

warfare—all are happening within a very short period of time. They are all inextricably linked.

The Biological Convention, for example, has a provision that states that the ratifying nations will work for a new chemical treaty in addition to the Geneva Protocol. The Geneva Protocol bans use of toxic chemicals in warfare. The Biological Warfare Convention contains language which says that the ratifying nations will work for a new treaty to restrict research, development, testing and stockpiling of toxic chemical agents.

Inclusion of herbicides in the Administration's interpretation of the Geneva Protocol, many observers feel, will permit U.S. ratification of the Biological Convention. As it is now, the Biological Convention is being held up pending a response from the Administration as to its interpretation of the Geneva Protocol. The ratification of the Biological Warfare Convention will, in turn, indicate our intention to comply with that provision in the Biological Convention which relates to a chemical arms control treaty. The resolution of the current stalemate on verification of chemical arms control which is presently delaying action on the new treaty in Geneva is dependent upon strong indications on our part to express good will and cooperation.

Exclusion of herbicides from the Geneva Protocol and adoption of binary chemical weapons will, in my opinion, severely jeopardize progress in all of these linked events in controlling development of chemical agents of death and destruction.

International opinion notwithstanding and the dangers to the environment and human health notwithstanding, the military continues to insist that herbicides must be retained in America's arsenal. The latest available policy statement by the Army on this subject appeared during hearings on DoD's fiscal year 1974 appropriations request. The Army asked for $530,000 for exploratory development in the field of "vegetation control chemical investigations." The DoD representative noted:

> We are continuing investigations in the area of vegetation control in an effort to significantly improve our current capability. We are looking for ways that herbicides can demonstrate their effects at a more rapid rate; agents which are effective in lesser concentrations; and agents which are nonherbicidal defoliants. . . . As you know, the President made the decision that in the future we could use no herbicides not USDA approved. Therefore, we are doing no work in the development of new herbicides. We are doing a small effort in development of delivery systems to insure that we have the capability.

In this year's budget request, DoD has asked for $5.8 million for part of the procurement of a binary system for nerve gas. The remaining request is classified. Some experts feel that the total program cost converting our chemical stockpiles into a binary system will cost as much as $2 billion. This expense—together with the international implications which I have spelled out—add up to a momentous decision which Congress should carefully scrutinize.

If we have learned anything from recent developments in America's chemical warfare capability, it is that we have permitted the Department of Defense to make too many independent decisions on weapons policies. DoD should provide Congress with a full and complete arms control impact statement before we authorized any new weapons procurement.

Too often arms control policies and negotiations have been conducted without benefit of foresight. Bureaucratic momentum within the Department of Defense and other related agencies and the onrush of technological breakthroughs have generated research and procurement of agents of death and destruction without adequate consideration for what the consequences are for the peace of the world.

If Congress required an analysis on the full impact of the proposed adoption of binary munitions, we might be able to isolate the relationship between this proposal and the threat to the world of chemical weapons proliferation. Too often these research and development decisions are made in the context of some isolated logistic program or with some specific or peculiar requirement in mind. The binary program has been on-going for some 15 years. The military has been forced to face the fact that public opinion is strongly against the transportation of toxic nerve agents needlessly from one storage site to another and that concern is easily aroused about proposed destruction procedures for deteriorating munitions. Placing this problem in the environment of a massive defense bureaucracy, pressed forward by a dedicated corps of chemical war-

fare specialists anxious to justify 20 years of research and development, has meant a shift of stockpiles from its current configuration to the binary system with its reported safety from hazards in stockpiling and shipping.

But what about the impact of a decision to procure binaries on events and policies outside the immediate domestic problems associated with existing stockpiles? Who examined the effect on the Geneva negotiations? Who factored in the potential risks of escalation of the use of the safer to manufacture and handle binary munitions as mass destruction weapons within non-nuclear countries? Who conducted the risk benefit analysis in terms of our current very delicate relationships with our NATO allies? And finally, what conclusions were reached if such analyses were conducted?

If we had a requirement for arms control impact statements for new weapons programs—a proposal I recently introduced in the Senate—we might be able to get some answers to these questions. Had we had a system of arms control statements a decade ago before full-scale utilization of herbicides in Vietnam, the ecological catastrophe we have perpetrated on the Vietnamese land and people might have been avoided.

In summary, I would like to reiterate my support of the Geneva Protocol with the understanding that herbicides are included. To this end, I shall introduce once again in the Senate, the same proposal that I introduced in the last Congress—namely an Executive Understanding that clearly states that the Geneva Protocol prohibits the use in war of chemical herbicides.

I am hopeful that this series of hearings will be a prod to the Administration to report to Congress the results of its 3 years of reconsideration of the Senate view which is embodied in the Executive Understanding which I originally introduced in January, 1971. Should we hear a favorable response from the Administration, the Senate could then get on to the business of ratifying the Geneva Protocol and the Biological Convention. And then our negotiators could perhaps get on with their business of negotiating an expanded treaty on chemical munitions.

ADMINISTRATION POSITION AFFECTS BOTH BW CONVENTION AND 1925 PROTOCOL

Mr. ZABLOCKI. Thank you, Senator, for your excellent statement and your summary.

It appears to me that since we are not now engaged militarily anywhere in the world, indeed, during this period of détente, it is an ideal time to pursue the ratification of the Geneva protocol and other agreements to prevent the use of chemical and biological agents for military purposes.

You have touched upon the failure to ratify the Geneva protocol as having a significant effect on current disarmament negotiations on chemical warfare arms control at Geneva. Would you agree that the failure of the United States to ratify the 1925 protocol is also a significant factor in the delay of the ratification of the biological warfare convention?

Senator NELSON. Yes; I think it is. I can't speak for the Senate, or the Foreign Relations Committee, but it is my understanding the committee would like to deal with both of those protocols, and that it would like a response from the administration as to whether it agrees now with the Foreign Relations Committee interpretation of the Geneva protocol as to the inclusion of herbicides in the prohibitions of the Geneva protocol. If they receive a positive response from the administration, it is my guess, though I am not on the committee, that we could get ratification of both of those protocols.

RATIFICATION A STEP TOWARD ARMS CONTROL

Mr. ZABLOCKI. Senator, in your opinion, what significant advantage would accrue in U.S. foreign policy if the protocol could be ratified immediately without the exclusion of herbicides and riot control agents?

Senator NELSON. To be honest, I think it is a significant useful step forward in the whole negotiations in arms control, if the protocol with the appropriate interpretation is ratified. I think the next step has to be to try to design an agreement which is being talked about in Geneva to prohibit the further research, development, and stockpiling of these weapons. They are really quite unnecessary and have disastrous potential effects worldwide, particularly the biologicals and the herbicides. So I think the general protocol is really part of the bigger picture of negotiations on arms control.

If we go ahead with the binary program and spend hundreds of millions of dollars and then others proceed to do the same, it will escalate the competition in nerve gas weapon systems. Furthermore it will make it much more difficult to reach agreements on developing and producing new weapon systems to deliver more effective biological and chemical weapons in warfare.

EXCLUSION OF HERBICIDES AND TEAR GAS: SENATE VERSUS THE EXECUTIVE

Mr. ZABLOCKI. Senator, I have one additional question, and I don't know whether I really should ask it. I don't intend to embarrass you, but could the Senate Foreign Relations Committee report the Geneva protocol with the stipulation that it does not agree with the exclusion of herbicides and tear gas and then report it back to the executive branch so to speak, with an amendment.

Senator NELSON. I guess they could, but the chairman and members of this committee are probably more familiar with what legally that might mean to the international community. If the Congress approved it clearly stating that it did include herbicides and the President is saying that it didn't, I don't know what the effect of that is and what interpretation the international community could put on it. I would suspect that it would raise a very serious doubt in anyone's mind as to whether in fact herbicides were included in the protocol.

Mr. ZABLOCKI. We are coequal branches in our Government, and I think the Senate could voice its approval or disapproval of a particular provision and send it back to the Executive. I hope that will not be necessary.

Thank you, Senator.

Senator NELSON. Thank you.

Mr. ZABLOCKI. Mr. Broomfield.

DELAY IN RATIFICATION?

Mr. BROOMFIELD. Thank you, Mr. Chairman.

Senator, why has the Senate Foreign Relations Committee just been sitting on this? I think they have to accept some of the responsibility. The longer they keep dillydallying around, the more new techniques will be developed in this field. What is your answer to that?

Senator NELSON. Well, as to the Geneva protocol, it is 3 years now, and I didn't bring the statement with me, but the President at that time expressed his interpretation of the protocol as to not include herbicides as a prohibited chemical. The Foreign Relations Committee stated their position did include it and sent a letter to the President in 1971. As of this date so far as I know, there has not been a response as to whether the administration had modified its position or adhered to it, and that is what is holding up the protocol.

Mr. BROOMFIELD. How about before that time? How about the previous administration? I don't recall President Johnson sending up any kind of request on this at all.

Senator NELSON. I think the protocol was negotiated in 1925, so I think we can equally criticize every administration and whatever part any Congress may have played from that date to today. I was not making any special criticism of this administration; the protocol has been around for nearly a half century.

Mr. BROOMFIELD. I thank the Congressman.

Mr. ZABLOCKI. Governor Thomson.

ACTION REQUIRED TO BREAK THE STALEMATE

Mr. THOMSON. Thank you, Mr. Chairman.

I want to welcome the Senator from Wisconsin, our contemporary in the other body. We have been very interested and looking forward to hearing your views on this subject because you have become somewhat of an expert and acknowledged in this field.

I would like to just ask what further action seems to be required by the Congress in order to break the stalemate between the Senate Foreign Relations Committee and the administration's interpretation of the protocol?

Senator NELSON. Mr. Thomson, I don't know that I can answer that except that I think in fact that these hearings by this committee are a very useful educational device in getting visibility to the issue. It is like so many other things. If they are not brought out and discussed, and if they don't become part of the political dialog of the country, we don't get any action. So I think the committee is performing a very important function in thrusting this upon the attention of the Members of Congress and the public.

NO REASON TO CONTINUE HERBICIDE EXCLUSION

Mr. THOMSON. Were there any really significant reasons for continuing to exclude herbicides from the Geneva protocols as proposed by the President?

Senator NELSON. I don't think there are any good reasons. I am no expert on any of this, but the only thing that I have read extensively on is the literature, including the study by the National Academy of Sciences, on this herbicide, defoliation, and its implication and effect as well as its military value. I conclude that really it had no genuine military value. That is why we debated that question on the floor of the Senate and offered an amendment to prohibit its use in Vietnam. And this was done when the war was still on.

The arguments against prohibiting its use, on the floor of the Senate, I thought were quite weak. And in fact the Pentagon did stop its use, even though the war was still going on. So they must have concluded themselves that it was not of great value.

ECOLOGICAL DAMAGE OF HERBICIDES

It is clear that the damage is very extensive, and nobody knows how serious the long-term ecological imbalance that has occurred will be in terms of breeding grounds for fish on which the Vietnamese live, the destruction of valuable forests which may never come back at all because the area might very well be overrun by valueless grasses and other scrub trees.

So I think, in any event, it is counterproductive to use it. It is not very valuable militarily, and it poses, I think, a worldwide problem because any country can use it. All you need is a little tiny airplane equipped to spray that stuff out on the forest. So it is a very cheap weapon, and you could have this being sprayed on all parts of the world in little wars between countries. And the result would be to create great damage to the planet with no military advantage.

So I see no purpose in permitting the continuance of its use. I understand there is some legislation in the House of Representatives to prohibit its use.

Mr. THOMSON. Senator, you are worried about the fish life in Vietnam. Has it not affected the fish in America, and we have not dropped in anger any herbicides in this country? What is the effect of the herbicidal use in this country on the American bald eagle that flies up along the Mississippi River in your home State?

Senator NELSON. Well, I think it has been disastrous, and it is not, of course, as the Congressman knows, a question of simply being concerned about fish or a bald eagle, because when you conduct activities that cause extinction of any critter, you should always keep in mind John Donne's words, "Never send to know for whom the bell tolls; it tolls for thee," because when you create these great upsets, you are having dramatic upsets on humans.

THE CASE OF DDT

The DDT case is instructive in the discussion of 2,4,5–T. DDT has been a disaster for this country, and we don't even know yet the long-term implications of our massive use of DDT. It has a half life of at least 10 years. It has infiltrated the tissue of almost every living creature in this country, including marine life, the human, and other animals. Its disastrous first consequences showed up in the bald eagle and the Paragon Falcon birds.

At the end of the food chain, there were heavy concentrations of DDT because of magnification in the food chain. We can see that it indeed can destroy the bald eagle. We don't know the effect of DDT on all other creatures. But it is major, serious issue—important not only to the bald eagle and its mate but important to us, too.

Mr. THOMSON. You include the human then in those creatures that you mentioned?

Senator NELSON. I include the human among them. It can be disastrous to the human species to continue the massive use of all kinds of

herbicides and pesticides without having any long-term studies to see what their environmental implications are for us and for every other creature in the food chain.

SIGNIFICANCE OF NONRATIFICATION

Mr. THOMSON. Senator, is the failure to ratify the Geneva protocol having any significant effect on current disarmament negotiations on chemical warfare control at Geneva?

Senator NELSON. I probably should not address myself to that because I have been following it casually, but the biological protocol includes a clause on chemical weapons negotiations and moreover, discussions ongoing in Geneva on chemical arms control involve the issue of including herbicides in the definition of chemical weapons. We have not reached any agreement on this issue, so I am assuming that the fact that the United States has not ratified the Geneva protocol is having some effect. But I think you better ask somebody who has followed it much more closely than I have for an informed answer.

Mr. THOMSON. Thank you very much.

Mr. ZABLOCKI. Mr. Biester.

Mr. BIESTER. Thank you, Mr. Chairman.

Senator, I also wish to welcome you here, and am pleased to hear your testimony this morning.

I am wondering if you draw, or does anyone in consideration of this matter, draw a distinction between herbicides and riot control agents? You seem to have lumped them here together, and I notice in the resolution offered in the United Nations they were placed together, and I am wondering if anyone has considered this distinction.

Senator NELSON. Well, most of the nations of the world do include riot control agents, but if we were to put them on some scale of importance I would consider that if riot control agents did not inflict damage permanently, I would consider them inconsequential compared to herbicides. I do not mean to infer that riot control agents are not consequential, but compared to herbicides, their danger is inconsequential.

U.N. RESOLUTION OF 1969*

Mr. BIESTER. Do you detect anywhere in the votes on the resolution in 1969 in the United Nations or in the remarks or papers of the participants in that discussion a willingness on the part of some of the 36 countries that abstained to vote for an inclusion of herbicides and against an inclusion of riot control agents.

Senator NELSON. What was the last part of that, an inclination by the 36 that abstained to do what?

Mr. BIESTER. They would vote for inclusion of herbicides but not for inclusion of riot control agents.

Senator NELSON. Well, I read that U.N. debate, that was so long ago that I cannot recall precisely. The distinguished woman—Mrs. Myrdal—lead the debate as I recall it. What sticks in my head is that the 36 abstentions were mostly countries who didn't want to affront the United States. That is my recollection of my interpretation at that time.

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*The text of the 1969 U.N. resolution appears in the appendix on p. 372.

MAJOR NATIONS HAVE RATIFIED PROTOCOL

Mr. BIESTER. And what nations do not currently adhere to or have currently failed to ratify the Geneva protocol?

Senator NELSON. I don't have that list with me. I think every major nation in the world has already ratified it.

Mr. BIESTER. The Soviet Union has ratified it?

Senator NELSON. Yes.

Mr. BIESTER. China has ratified it?

Senator NELSON. I better not be furnishing information for the record that stands on its own. I have forgotten. It has been 3 or 4 years since I looked at that list.

Mr. BIESTER. Thank you very much, Mr. Chairman.

Mr. ZABLOCKI. Mr. Fraser.

THE TEAR GAS ARGUMENT

Mr. FRASER. Thank you very much, Mr. Chairman.

Senator, I want to apologize for my tardiness. There is a Democratic caucus underway discussing committee jurisdiction reorganization and that accounts for the absence of many Members on our side.

If I may just make clear my understanding, you are seeking to have the Senate ratify the Geneva protocol with the understanding that it encompasses herbicides in its ban on use of chemical warfare?

Senator NELSON. Correct.

Mr. FRASER. And what has been on the table at Geneva, not from us but from other nations, is a proposal to ban the manufacture or the maintenance of stockpiles in the same field?

Senator NELSON. That is now under discussion; yes.

Mr. FRASER. We have not taken the first step—ratification of the now 49-year-old Geneva protocol—and as I understand it we have failed to table or put down a position for the United States in the Geneva conference on this issue of manufacture and the maintenance of stockpiles.

Senator NELSON. I don't think we have taken a specific position. The negotiations are ongoing, but as I said a few moments ago I have not followed them that closely.

Mr. FRASER. My recollection of the argument over tear gas is that the allegations were made that we were using it in conjunction with our war effort to, in effect, drive the enemy out of protected places so that they would be exposed to artillery fire, and thus the tear gas was an integral element of our war making or our capacity to carry on the battle.

HERBICIDES: A LETHAL AGENT

Senator NELSON. There have been several arguments about that. One of the responses of the military was that it was a humanitarian use of that instrument in special circumstances. One example given is a number of soldiers and civilians within a cave with weapons who will not come out. Some argue that it was humanitarian to put in tear gas which would do no permanent damage to make them come out. This, it is argued, avoids blowing up the caves.

As to the extent, use and military value of riot control or tear gas, my knowledge is limited to what I read in the papers. The issue I paid

special attention to in Vietnam was the herbicide question and the environmental effects and health implications of dioxin in 2,4,5–T which appears to persist in the environment.

Only 6 parts per 10 billion of dioxin in laboratory tests killed the guinea pigs in the test.

Now that is an incredible lethal agent. To be introducing that into the environment, and to have it magnify in the food chain as it appears to do in the limited tests that have thus far been done poses a very serious matter because it may end up that a good many parts per billion are in living creatures including human beings. Scientists still don't know what amounts are built up in living creatures. So there is the health question and the environmental one, and that is the agent I have paid close attention to so far as Vietnam was concerned.

INDEPENDENT LEGISLATION ON HERBICIDE USE?

Mr. FRASER. Your thought is that if this subcommittee looks at the matter and comes to some conclusion, this may have some influence in the Senate?

Senator NELSON. I think it would have some effect. And I think it is worth considering whether we should just legislate a prohibition against it. It is not my business to instruct this committee, but I would like to see one House or the other require the military to come in and really specifically justify the military value of the use of this herbicide. I don't think they could.

Mr. FRASER. I see. Apart from the ratification of the treaty and the understanding that it encompasses the use of herbicides, we could independently legislate with respect to its use by our own Armed Forces?

Senator NELSON. I think you could. I don't think there is any place in the world where this instrumentality has to be used.

Mr. FRASER. Thank you very much.

Mr. ZABLOCKI. Thank you, Senator. I know your time is valuable. We appreciate your coming before the committee this morning. Your testimony was very helpful.

Senator NELSON. Thank you. I appreciate the opportunity.

Mr. ZABLOCKI. Our next witnesses are Representative Patricia Schroeder of Colorado and Representative John Dellenback of Oregon. We will hear them as a team.

The Honorable Wayne Owens of Utah, who is the chief sponsor of the resolution before us is unfortunately ill and therefore unable to appear this morning.

We will hear Congresswoman Schroeder first.

STATEMENT OF HON. PATRICIA SCHROEDER, A REPRESENTATIVE IN CONGRESS FROM THE STATE OF COLORADO

Mrs. SCHROEDER. Thank you.

First, if it is all right with the committee, I would ask unanimous consent that my written statement be inserted in the record and then attempt to briefly summarize some of the things that I think are most important.

Mr. ZABLOCKI. Without objection, your complete statement will be made a part of the record after your oral summary.

U.S. POSITION: NO FIRST USE, BUT RETAIN CAPABILITY

Mrs. SCHROEDER. Mr. Chairman and members of the committee, I am delighted that you decided to focus on this area. I have to confess that the way I became interested in it was because we have one of these large stockpiles of chemical weapons in my backyard in Denver, and so there was an immediate concern, and that is why I became very interested in what was going on.

I proposed to direct my remarks mainly to the status of the negotiations in Geneva of the Conference of the Committee on Disarmament. Last August, in 1973, I attended sessions for over a week in Geneva as a House of Representatives observer appointed by the Speaker. The stated position of the United States at these meetings as regards chemical weapons was then and remains today as follows: We will not be the first to use them, but retain a chemical capability in order to deter enemy use of such weapons, and to provide a retaliatory option in the event deterrence fails. We insist, moreover, that any meaningful agreement restricting these weapons be accompanied by verification procedures capable of producing the requisite observations or data entrusted to nations wishing to reassure themselves.

MAIN THREAT IS TO EUROPE

So in essence what we are saying is that we will never use chemical weapons first. Then what the Geneva conference is looking into is whether we can come to a multilateral agreement on prohibition of development or production or stockpile. There is no agreement at the moment, and any one of these three things, or all of or some combination, might be the subject of agreement.

I would like to look at the U.S. position because I feel it is one of the reasons these talks have been stalled for about 2 years. I think in saying that we won't use these weapons first, but need them to deter, we have to examine what the threat would be to the United States. I think that the threat to the geographical United States per se is very, very small. The main threat is to our NATO Allies in Europe.

COUNTERMEASURES FOR CW

I think also in looking at the threat we often blur chemical and nuclear concepts. I think that unlike nuclear arms we do not need to worry so much about balance because I don't think that in this area deterrence lies in our ability to respond in kind, one for one, mainly because in chemical warfare there are defensive measures that will work. We don't have the same defensive capability with respect to nuclear weapons.

Let me expand. As anyone in the chemical warfare area knows you can defend your troops against the use of chemical weapons through such basic countermeasures as masks and ponchos and other such equipment. Granted it is cumbersome, but it is available. The effective use of chemical weapons by either side, then, means seizing the tactical advantage of surprise—to surprise the other side by using them first.

And obviously, if any country intended to use them against us, it is going to be prepared to defend against them if we respond in kind. Therefore, I think we have to reexamine our position that we are only

holding these chemical weapons to deter the other side, because I would think that anyone who would use them first against us would be adequately prepared to defend against our counteruse.

INADEQUATE FORWARD DEPLOYMENT

Next, I think that if the retaliation in kind were truly effective—and NATO is the main area where I think the use of chemical weapons is the most probable—it seems to me we do not have adequate forward deployment. As you know, there is one area in Germany where we have stockpiled chemical weapons. The supply is small and if we were to need them in the European Theater we would have to airlift them from the United States, which would mean a great delay. So I think if we are really serious about needing these weapons to respond in kind, we certainly haven't demonstrated that need in our deployment policies.

VERIFICATION PROBLEMS

Many have argued that we cannot have an agreement based on good faith alone, and insist on foolproof verification. The problem with chemical weapons, of course, is that you can store them almost anywhere, you can manufacture them almost anywhere. Again, we have a different kind of animal than in the nuclear area.

I think we also have to be very careful about the proliferation, because chemical weapons are much cheaper to manufacture and almost any country with any manufacturing ability can make them. Maybe we have to look at this again and consider whether the kind of verification that we have required in the nuclear area might not be less critical in this area.

REASONS FOR AMERICAN POLICY

Well, why do I think we have not looked at our policy this way and have not reconsidered our stance in Geneva? I think part of the reason for the intellectual sterility of American policy in Geneva has been the SALT I backlash, that we have been a little concerned as to how fast we want to proceed, after some of the comments on SALT I.

Another is this diplomatic stare decisis that I mentioned before. In other words, we take a nuclear verification formula and because we fear the precedent of anything less try to apply it to another class of weapons that is not analogous at all. We say if we cannot have on-site inspection, or whatever else, we cannot proceed to negotiate.

Finally, the Committee on Disarmament is a multinational group, and unfortunately in our country it seems that we have put low priority on multilateral negotiations and have done much better with bilateral agreements, as we know from just having heard the discussion on the Geneva protocol.

INVENTION—THE MOTHER OF NECESSITY

Then, too, there is the matter of institutional inertia. In 1962 the Army Materiel Command absorbed many of the functions of the old Chemical Corps. They are now asking to recreate a new kind of chemical weapon, a binary. Sitting on the Armed Services Committee I must

say that once you vest some bureaucratic branch with a certain weapon system it is unlikely that they are going to come in and ask you to dismantle that weapon system or to halt its improvement. So I think we have a case of that holding us back, too.

CHANGES DICTATED BY TECHNOLOGY ABILITY

We almost find these different groups saying that if we have the technological ability to change directions then we absolutely must; invention becomes the mother of necessity.

So what I am saying is that I certainly commend the committee for looking into our national policy on chemical weapons. I think anything we can do to restate it, to clarify it, would certainly help the American negotiating team in Geneva.

I think our Arms Control and Disarmament Agency under Dr. Ikle is doing an excellent job.

I certainly appreciate the opportunity to testify here this morning. Thank you.

[Mrs. Schroeder's prepared statement follows:]

PREPARED STATEMENT OF HON. PATRICIA SCHROEDER, A REPRESENTATIVE IN CONGRESS FROM THE STATE OF COLORADO

Mr. Chairman, I very much appreciate the opportunity to appear before this subcommittee today. I feel these hearings can prove most useful in determining why the Conference of the Committee on Disarmament appears to be stalled on the issue of controlling the development, production, stockpiling and use of chemical warfare weapons. A thorough analysis of the issues involved may encourage representatives of this government to develop an affirmative position of their own, thereby moving the Geneva negotiations off dead center.

I do not pretend expertness in the subtleties of international arms negotiations or, for that matter, in the technology of chemical weapons. Last year's disclosures of a lethal chemical stockpile in my Denver backyard, though, brought me in quick order to begin learning all I could about this part of our military arsenal and efforts to negotiate its demise.

The CCD was organized in 1962 as the Eighteen Nation Disarmament Conference. It was enlarged to 26 members in 1969, at which time it was given its current name. While public attention has tended to focus in recent years on the intercontinental dashes of our talented and ubiquitous Secretary of State and his essentially bipolar approach to issues of disarmament, it should not be forgotten that the CCD has played a pivotal or contributing role to a number of major arms control agreements, including the limited test ban treaty, the nuclear nonproliferation treaty, the seabeds arms control treaty, and, most recently, the convention banning biological and toxin weapons. Moreover, precisely because the CCD membership involves many nations, including several which would hardly qualify as world powers, its accomplishments should be cherished and its continued existence regarded as an important goal of American foreign policy. Last October's events in the Middle East should serve to refresh our recollections of how the problems and disillusionments of small nations inevitably affect the security of large ones.

In August, 1973, I attended several CCD sessions in Geneva as a House of Representatives observer appointed by the Speaker. The stated position of the United States as regards chemical weapons was then, and remains to this day, as follows: We will not be the first to use them, but we retain a chemical capability in order to deter enemy use of such weapons, and to provide a retaliatory option in the event deterrence fails. We insist, moreover, that any meaningfully comprehensive agreement restricting these weapons be accompanied by verification procedures capable of producing the requisite observations or data and, in addition, entrusted to the nations wishing to reassure themselves. (For a more detailed discussion of the verification question I refer the subcommittee to the "Work Program" (CCD/360) submitted to the Conference by the U.S. delegation on March 20, 1972. As far as I know, this is the last constructive contribution our government has made to the progress of the negotiations.)

That position, enunciated time and again by Ambassador Joseph Martin, Jr.—usually as part of the critique of proposals submitted by other nations—struck me as a non-starter, more an excuse for not reaching agreement than an attempt to reach one. This perception was shared by the delegates of several attending nations and, as I was to learn through private discussion in subsequent months, by a number of individuals within our own arms control establishment. Among those most conversant with the problem of controlling the weapons of chemical warfare and most anxious to solve that problem a number of premises are accepted as beyond dispute:

First, the United States (proper) faces no threat whatsoever from a chemical warfare attack. To the extent any threat exists at all it is to our NATO allies as part of a massive attack by Warsaw Pact Nations.

Second, unlike the situation that applies with respect to the nuclear balance of terror, the primary deterrence to a nerve gas attack is not the ability to retaliate in kind. Casualities from such an attack can be reduced to negligible proportions through the utilization of countermeasures as basic as a pancho and a gas mask. The intrinsic tactical advantage rests therefore with the nation initiating a surprise first-use of chemicals. Such a nation is likely to anticipate retaliation and equip its troops with appropriate defensive materials. The real deterrence to a surprise attack, then, is an adequate chemical defense plus the credible threat to retaliate with conventional or tactical nuclear weapons depending upon the severity of the initial attack.

In this area, it is worth noting that neither we nor our European allies are either adequately trained or equipped to defend ourselves against a nerve gas attack. Army chief-of-staff, General Creighton Abrams, admitted as much this past February in his post-mortem on last October's war delivered to the House Armed Services Committee. In one respect this indicates an area where improvement is necessary. Perhaps more importantly it shows the low probability our military planners attach to such an attack.

Third, even were retaliation in kind an effective deterrent, the ability of NATO forces to do so effectively is limited. Due to excessive resupply times, chemical weapons stocks positioned in the United States cannot be considered part of a credible retaliatory possibility. Further, there is only a single NATO storage area for chemical weapons, located in Germany. That Government would be far from unhappy to see those stocks removed and, in any event, would be precluded by West German political exigencies from approving expanded facilities or even the introduction of new types of chemical weapons.

Fourth, a number of the world's industrialized nations have the capability today to produce chemical warfare weapons. Agreements to limit the production or stockpiling of chemical warfare agents are at best difficult to monitor and would always be subject to substantial reliance on the good faith of the signatory nations. From a technological point of view, unlike those systems regulated by the SALT I accords, for example, air or satellite recognizance would be of limited, if any, use. And the opportunities for the secret manufacture and storage of nerve gas are substantially unlimited.

Fifth, a unilateral renunciation or an unverified comprehensive prohibition on all or part of the activities related to the conduct of chemical warfare would not increase the risk to U.S. or NATO forces and may in fact decrease it by placing political and, perhaps, military constraints on potential aggressor nations. Again it is worth noting the primary constraint against surprise first-use by an enemy comes not from our essentially fictitious ability to retaliate in kind but from effective, passive defenses plus our ability to respond with conventional or tactical nuclear weapons as the occasion may dictate. That sort of deterrence would not be hampered and might actually be enhanced by our abandonment of the chemical warfare concept altogether.

Given these widely shared premises and juxtaposing them with the American bargaining position it was not surprising to see the CCD adjourn last summer in an atmosphere heavy with pessimism and with several of the participating nations—nations otherwise friendly toward the United States—dubious as to American intentions. The Administration's autumn decision to press ahead with the development of binary nerve gas weapons further blackened the picture.

Where many nations last summer regarded the United States as having assigned a rather low priority to CCD activities, by mid-March as the 26 nations reconvened one of the more influential western delegates (Dr. Alfonso Garcia Robles, Leader of the Mexican Delegation) went so far as to suggest that we planned to trigger a chemical arms race. Indeed the mood of the CCD at this

point is such that if an agreement imposing meaningful restrictions in the area of chemical warfare is not soon achieved the existence of the organization will be threatened.

My purpose here is not to undertake an exhaustive review of the military and nonmilitary pros and cons of the binaries, Mr. Chairman, which as you know involve two "relatively non-toxic" chemicals capable of generating lethal nerve agent when mixed. I believe other testimony will address these questions.

Rather my intention is to assess binaries from the standpoint of their impact on the ongoing work of the CCD, and here my conclusions can be summarized in a single word: disastrous.

While binaries add little to America's anti-chemical warfare deterrent, they do significantly add to such verification problems as already exist. Even the definition of agents to be included in an accord would not be easy. When we deal with binaries, after all, we are dealing with sets of individually harmless or relatively harmless substances, chemicals that may have perfectly benign non-military value to the private sector. The production of many such substances could be accomplished by a nation's commercial chemical industry. Indeed, this is one of the binaries' prime recommendations. How then would an agreement banning binaries along with traditional nerve agent be worded? How could it ever be policed? What assurances could there ever be that existing stockpiles have been destroyed?

This, however, is only part of the problem. Proliferation is another. There is much apprehension that binary chemical weapons would become the "poor man's atom bomb." They are of far greater military significance to smaller countries than to larger ones, and, given their heralded ease of manufacture and transport, pressures on the major powers to assist their smaller allies by equipping them to use the binaries would eventually become severe.

Then there is the matter of forward deployment of any binary weapons or agents produced by the United States. Included in this year's military budget are funds to commence the manufacture of binary agents at the Army's Pine Bluffs, Arkansas facility. Common sense, though, tells us that these chemicals can serve no effective purpose in Pine Bluffs, or for that matter, anywhere else in the United States.

The howitzers, missile warheads, aircraft massive-bombs, cluster-bombs, air-to-ground rockets and aircraft spray-tanks that will eventually fire these chemicals—as well as the agents themselves—would take weeks or months to transport in an emergency and would, in the process, absorb a considerable percentage of our airlift capacity.

Yet the alternative of forward deployment is equally unacceptable. It would play havoc with the politics of our western European allies, introduce a new and mischievous element into ongoing MBFR negotiations and greatly increase the risk that our putatively defensive motivations could be misconstrued by the Soviets thereby encouraging development and deployment of their own binary chemical arsensal.

Small wonder then that our decision to commence production of binary weapons has been greeted with alarm by many members of the CCD. Small wonder that many participants in international arms control efforts, including several staff members of the American team, would prefer an accord banning chemical weapons based upon limited verification, self-verification or no verification at all to the position, or more correctly the nonposition, of the United States. The latter substitutes for the uncertainties of an arms control agreement the certainty of a new and dangerous chemical arms race.

What accounts for the intellectual and moral sterility, the total lack of innovativeness, of the current American posture? Several suggestions have been advanced by those closest to the scene.

First, there was the unfortunate backlash against the SALT I accords from certain segments of the public and the Congress. The Administration, having been once smitten, is now somewhat gun-shy about bringing home agreements which do not on their face reflect a major American bargaining victory. This is particularly true in the current period when President Nixon, to paraphrase Von Clauswitz, is attempting to keep his right flank strong.

Second, there is the precedential element to any agreement negotiated. We have for about two decades insisted upon on-site inspection with respect to certain types of agreements in the area of nuclear weaponry, and while banning nerve gas is an entirely different matter there is at work bureaucratic fear of what can best be termed diplomatic stare decisis.

Third, the plain fact is that we have not assigned a very high recent priority to CCD affairs, including the control of chemical warfare. We have had difficulty gaining domestic approval of past multi-lateral arms treaties and protocols and our emphasis today is on the bi-lateral approach. In the grant orchestration of all our international negotiations, everything is playing second fiddle to SALT, including CCD.

But above all else the real answer may lie in the sort of institutional inertia that tends so often to generate policies. The Army Materiel Command, which in 1962 absorbed the functions of the old Chemical Corps, would after all have very little to do—particularly in the light of the restrictions placed upon its activities by the Congress in 1969—were it not developing, procuring and stockpiling one variety of nerve gas or another. The development of binaries promises to ripen into a $1.5 to $2.0 billion effort that will keep the Materiel Command in business at least through 1985. And while the program itself creates more problems than it solves, that seems a matter of little concern. As one British critic of the binary program recently noted: "In circles where technological prowess is highly valued, it seems to be a fact of life that the mere existence of a technological solution, even one to a problem or no obvious moment, has a tendency to upgrade the status of the problem to that of a bad situation requiring immediate remedy." Invention, in other words, becomes the mother of necessity.

This may all seem a bit cynical, but my exposure to this problem has persuaded me that chemical warfare is important chiefly to the old Chemical Corps, that the Army Materiel Command is the prime mover within government circles for experimentation in the area and the prime road block to international accord. I am further convinced that the Arms Control and Disarmament Agency under the able leadership of Fred C. Ikle could press meaningfully ahead in the direction of international control of lethal chemical weapons if it had the active support of its own State Department, even of modicum of encouragement from the White House and the prodding of a concerned and enlightened Congress.

That is why these particular hearings can prove so positive a force. This will be a critical year on the arms control front. Accordingly, I believe that government witnesses should be drawn out in a number of areas. Is there any reason for technical—indeed insoluble—verification problems to permanently block an accord? I submit the answer is no. Would the expenditure of funds for the production of binary chemicals threaten the life and work of the CCD? I suggest the answer is yes. Does the development of such weapons, either as a retaliatory option or as a deterrent, serve our national security? No. Would such development and deployment impede verification of and compliance with any agreement and greatly complicate relationships with allies, adversaries and the other members of CCD? Yes. Are there at least two distinct voices within the government on this subject—those of the Chemical Corps and the ACDA? Yes. Has the CCP suffered from the failure of this government to assign a high diplomatic priority to its work? Yes. And, would the Conference benefit from the presentation of an imaginative, concrete and comprehensive American proposal? Yes again.

Mr. Chairman, now that I have answered most of my own questions, I would be delighted to attempt to respond to some of yours. Again, I appreciate your invitation for me to appear here and express my views and concerns.

Mr. ZABLOCKI. Thank you, Mrs. Schroeder.

Mr. Dellenback.

STATEMENT OF HON. JOHN DELLENBACK, A REPRESENTATIVE IN CONGRESS FROM THE STATE OF OREGON

Mr. DELLENBACK. Mr. Chairman, I would ask also for the sake of the subcommittee that my full statement might be made part of the record, and that I be permitted to make a brief summary rather than to read the statement to you which has been supplied to the members of the subcommittee.

Mr. ZABLOCKI. Without objection, your statement will be made part of the record after your summary.

UNITED STATES AT THE HEART OF CW IMPASSE

Mr. DELLENBACK. I would say just a few things, if I may, that I have touched upon in part in my statement and part not. It seems to me that for far too long a time now the United States has really been at the heart of this impasse. We are at a unique time now to study the matter as this subcommittee, deserving some commendation for so doing, has determined you are going to do.

It is time that a clear position was determined. The Vietnamese situation—which was at the heart of our difficulty for so many years because we were in the process of utilizing weaponry which caused problems in going forward with the ratification of the protocol—that is now behind us. We no longer have to face that particular situation, and hopefully we are in a position which is much freer as to what we now can do.

CRITICAL TIME

We are also, for another reason it seems to me, Mr. Chairman, at a critical time as to why we should move now. And that is that we face the decision time as to whether we are going to proceed with this proposed Army program to switch to binary chemical munitions. Before we allow the military to go forward with that kind of a move I think this subcommittee and the Congress ought to be facing the question of whether we need or want this arsenal of chemical weaponry. Because this is not only a question of what is happening with the 1925 protocol, what is happening with the 1972 biological convention, what is happening with the proposals that are in Geneva at the present time, but it goes way beyond that.

ARE CBW ADDITIONS NECESSARRY?

I would refer this subcommittee to something which is already in the minds of some of you. In fact as early as 1969 a group of 15 of my Republican colleagues and I made a study on this which was entitled, "CBW and National Security." We published it on November 3, 1969. If I may, Mr. Chairman, I would submit this or another copy of it to the subcommittee for its records.

Mr. ZABLOCKI. Without objection, the study will be incorporated in the appendix of the hearing.

Mr. DELLENBACK. Essentially it seemed to us that the heart question, as well as the hard question, is do chemical and biological weapons make a positive and necessary addition to our already impressive arsenal. I submit that is part of what your subcommittee, Mr. Chairman, is really in the process of looking at at the present time. The conclusion which is spelled out in our study is that in comparison with conventional and nuclear weapons CBS, chemical biological systems, were neither more cost-effective nor more certain to prove a deterrent to either limited or all-out war.

RISKS OUTWEIGH ADVANTAGES

Furthermore, the risks involved in developing CBS weaponry seemed to us to far outweigh any dubious advantages of such a system. We went into the details of that and we came out with certain recom-

mendations. I am pleased that since the time of that report the United States has made some progress along the lines which we recommended in our study. You will recall that in late November of 1969 President Nixon announced a series of decisions which were based on a National Security Council review of our policy. All biological weapons—and later on toxins were added to that—were denounced and the United States indicated that it would never be the first to use lethal or incapacitating chemical weapons. Irritant gases and herbicides were not included at that time. The President also said he would submit the 1925 Protocol again to the Senate, and he did so.

THREE STAGES: DEVELOPMENT, PRODUCTION, AND STOCKPILING

Since that time—and if I may, I would say this in further elaboration of the question you asked, Mr. Fraser—the question is where do we now stand in connection with the protocols and conventions? As I understand the situation there is, of course, the 1925 Protocol which has been hanging fire for 49 years without our having acted on it. In addition to that there is a convention that came forth in 1972 that dealt with the development, production, and stockpiling of biologic and toxin weaponry, and that is actually out. The convention was submitted to the Senate for ratification in August 1972, and the Senate has not acted on that.

The present impasse that is taking place in Geneva, as I understand it, goes to the question of development, production, and stockpiling of chemical weapons. This means the question is in three stages. Two stages are in the hands of the Senate at the present time with no action to date, and the third one locked in an impasse at Geneva at the present time.

IMPORTANCE OF U.S. RATIFICATION

Mr. Chairman, you asked the question of Senator Nelson when he was here about why American ratification of the 1925 Protocol is important, and if I may add to what was said at that time in response to it, I would suggest that there are at least three good reasons: The first of which is that the United States was among those who originally proposed the Protocol in 1925, and our failure now after 49 years to ratify it has been a constant source of embarrassment to any further negotiations. Anytime we get to a very sticky situation and we are proposing something it is thrown back at us that the proposal we produced in 1925 has never been ratified by our Government. That is a sticky first hurdle for our people to get over.

Second, ratification which would present us with action taken by the Congress would have a very important binding effect for the future. While the President has taken steps at the present time—and I am pleased with the steps that he has taken—those are subject to reversal at any time in the future that a President elects to reverse them. However, if once we ratify that Protocol then we have taken a significant action in the form of a Congress moving into the issue, and it has much more effect in the future.

Third, Mr. Chairman, it seems to me that the ratification of that Protocol would very much enhance our efforts at Geneva to move forward from here. The impasse that is hanging us up there could very well be broken by that. So I would suggest at least those three reasons

for making this a first priority in considering what we should do.

I won't go into the discussion as my statement does as to where we are at the present time and why we have not ratified. You and the other members of this subcommittee are at least as aware of that as I.

NEED TO MOVE FORWARD

I think I would end up saying that the current session in Geneva, which is important, should be moved forward. As you know, it is hung up over two main problems: One, we are insisting on some acceptable means of verification that the terms of the convention would be carried out, and that has problems attached to it. It is not a simple thing. Second, we are concerned with the difficulties in segregating specifically what chemicals should be considered weapons.

We need to move forward. This is a time where it seems to me that we see a third stage in the development of an individual's involvement with society. When it was merely a case of what an individual did we could deal with what was a crime and what was a fault, and we could control the individual. And then we came into the situation where an individual was set off against a nation at times. And here we are at the present time where we must, under certain circumstances, subordinate individual rights because the risk to the Nation is so great that the individual right, in limited degree, must be subordinated to this.

We are almost, it seems to me, with this kind of weaponry to the situation where the interests of humanity are at stake. And we cannot afford to permit further development of this kind of chemical weaponry because just as if something threatens the state then individuals are going to go by the wayside if the state is damaged, so also if something really threatens humanity then states are going to go by the wayside if humanity falls, and this is part of what is at stake at this particular moment.

U.S. ONLY MAJOR POWER NOT TO RATIFY PROTOCOL

If I may make one more statement in response to Mr. Biester. I think that you will find, Mr. Biester, that the People's Republic of China has ratified the protocol. That the U.S.S.R. has ratified the protocol. That West Germany has ratified the protocol. That France has ratified the protocol. And with the ratification by Japan in 1970, the United States is now the only major power which has failed to do so.

You are aware also of the fact that on the U.N. vote on whether herbicides and tear gas were included in the terms of the protocol, the vote of those who went on record on it was 80 to 3, and the only 3 nations that voted against it were Portugal, Australia, and the United States.

I thank you very much, Mr. Chairman, for this chance to be with you.

[Mr. Dellenback's prepared statement follows:]

PREPARED STATEMENT OF HON. JOHN DELLENBACK, A REPRESENTATIVE IN CONGRESS FROM THE STATE OF OREGON

Mr. Chairman, I appreciate this opportunity to testify on my resolution, H. Res. 710, and the other resolutions before the Subcommittee dealing with the question of American policy on the use of chemical weapons in warfare.

From what I know of your proposed hearing schedule, it appears the subcommittee will be giving this entire question a very thorough review. I commend you for this. For too long now the United States has been at the heart of an international stalemate in the area of both biological and chemical weapons disarmament because we've been unable to resolve some crucial points in disarmament proposals and the Congress has yet to find its voice on the issue.

Moreover, the time is now optimum for the Congress to study the matter and determine a clear position. We are no longer involved in the Vietnam war where our own policy in using herbicides and tear gas placed us in an embarrassing position among those who had already ratified the 1925 Geneva Protocol. Furthermore, just two months ago the National Academy of Sciences released its long-awaited report on "The Effects of Herbicides in South Vietnam." While I have not yet read the entire report, I am hopeful that it will be helpful to the subcommittee and other Members of Congress in evaluating the wisdom of the U.S. decision to employ such weapons during the Vietnam conflict and their value to us in the future.

We are also at a point of decision on whether to proceed with a proposed Army program to switch to binary chemical munitions as we destroy our current stockpile of mustard gas and nerve gas. The fiscal year 1975 budget requests some $6 million for continued R. & D. on binary weapons and almost another $6 million to construct a facility at Pine Bluff, Arkansas, to begin producing such weapons. Before we allow the military to go any further with a new chemical weapons program, we must answer the question of whether we need or want an arsenal of chemical weaponry at all.

Most importantly, the President will be going to the Soviet Union for another summit meeting in June, at which point the question of chemical weapons disarmament will undoubtedly be discussed. With our delegation at the Conference of the Committee on Disarmament in Geneva presently facing an impasse, a Congressional statement on the matter might contribute to the making of some substantive decisions at the summit.

The particular resolution I introduced last year deals with two basic areas of this issue: first, the inability of the Senate to move forward with ratification of the 1925 Geneva Protocol, and second, the need for a Congressional review of United States policies in the chemical warfare field and of our reasons for including chemical weapons as part of our defense program. Let me address myself first to the second point of why we should even be stockpiling weapons of this type and what U.S. policy should be concerning their use.

In November, 1969, a group of 15 Republican colleagues and I sponsored a study entitled *CBW and National Security* which discussed the tactical and strategic implications of chemical and biological weapons. We began with the premise that the sole justification for developing and producing biological and chemical weapons should rest in their overall value to our national security. We could not accept the rationale that we should pour American money into these systems simply because other nations might be doing so. The question is, rather, do chemical and biological weapons make a positive and necessary addition to our already impressive arsenal?

We examined the basic characteristics of the various types of these weapons and some of the problems involved with their use in military situations. In comparison with our conventional and nuclear weapons, our study concluded that CBS was neither most cost-effective nor more certain to prove a deterrent to either limited or all-out war. Furthermore, the risks involved in developing and stockpiling CBW seemed to us to outweigh any dubious advantages of such a system.

Another issue we questioned in the study was the contention that CB weaponry is humane. While some of these weapons which merely incapacitate the enemy for a limited time might appear on the surface to be more humane than conventional weaponry, we noted that they are generally used in combination with conventional weapons, thus increasing the attacker's chances of inflicting casualties. In addition, the potential ecological damages caused by these weapons may be extensive, with profound effects on future generations.

Some would argue that the use of CBW might enable us to maintain a low-level conflict and prevent rapid escalation to an all-out war. It was our conclusion, however, that "the possibility of escalation results from the breaking of tradition, not from the military mission these weapons are assigned. Their employment indicates that conventional warfare cannot do the job and defeat is unacceptable. Thus it is unlikely that lethal chemical or biological agents could be considered less escalatory than tactical nuclear weapons."

Our final concern was that the mere possession of chemical and biological weapons increases the likelihood of their being employed. The ease with which we decided to introduce chemical weapons into the Vietnam war lends support to this contention.

Because the logical of our study suggested that the disadvantages of CBW far outweighed their marginal advantages, we recommended careful consideration of the following actions:

1) Eliminating all stockpiles of chemical and biological weapons, including any low-level chemicals designed for military use. This does not include riot control agents for crowd control in the U.S.

2) Publicizing the results of future research in the field of CBW.

3) Encouraging international agreements on the prohibition of chemical and biological production and usage.

4) Ratifying the 1925 Geneva Protocol.

5) Declaring that the United States will not use such weapons, but will respond to their use by adversaries with appropriate conventional or nuclear force.

I'm pleased to be able to say that since that time the United States has made some progress along the lines recommended in our study. As the Subcommittee Members will recall, shortly after our study, on November 25, 1969, President Nixon announced a series of decisions based on a National Security Council review of our policies. All biological weapons (toxins were included in February 1970) were renounced and the U.S. indicated that it would never be the first to use lethal or incapacitating chemical weapons. Irritant gases and herbicides, which the United States was using in Vietnam, were not included in the ban on first use. The President also indicated he would submit the 1925 Geneva Protocol prohibiting the first use of chemical and biological weapons to the Senate for ratification and he did so in August 1970.

Some progress was also made in disarmament talks on this type of weaponry at Geneva. The session in 1972 came forth with a convention proposing to bar the development, production and stockpiling of biological and toxin weapons (something the 1925 Protocol failed to do) and the convention was submitted to the Senate for ratification in August 1972. Unfortunately, however, the Senate Committee on Foreign Relations has not acted on the Convention—apparently because it has locked horns with the Administraiton over the 1925 Geneva Protocol.

In comment on the second major issue of ratification of the 1925 Protocol, I am convinced that American ratification of this treaty is very important for three reasons.

First, it was the U.S. which originally proposed the Protocol in 1925 and our failure to ratify it has been a constant source of embarrassment to our diplomats. Second, ratification, representing action by the Congress, would be binding on future Presidents, while our present stance could change with a new Administration. Third, the overall strength of the Protocol would be reinforced and our efforts at Geneva to eliminate stockpiling would be enhanced by our ratification. It should be noted that with Japan's ratification in 1970, the United States became the sole major power to fail to bind itself to the Protocol provisions.

Why haven't we ratified the Protocol? Because to date the President has insisted on adding an interpretation that tear gas and herbicides are not included in its provisions. I must agree with the Senate Committee. Tear gas and herbicides should be included in the prohibition.

It should be clear from the virtually complete abstinence since 1925 from the use of tear gas in war that most countries do in fact believe it to be outlawed by international law. A U.N. General Assembly resolution in 1969 indicated that the other parties to the Protocol felt it covered tear gas. If we were to attach an understanding of a different sort, it would only serve to weaken the force of the agreement.

There are additional reasons why a tear gas reservation is unnecessary and unwise. Such a reservation would really not preserve a valuable military option for the U.S. Tear gas is only effective against troops lacking simple gas masks. In addition, it could probably only be used in operations where the U.S. is not an ally of a Protocol adherent which feels that the use of tear gas for military purposes is prohibited. Both allies would want to follow similar weapons policies and the use of tear gas by the U.S. could easily lead to gas retaliation by our common enemy against both the U.S. and its allies. This would certainly be

completely unacceptable to any ratifying ally. Thus, realistic opportunities for using tear gas may be quite rare.

As far as herbicides are concerned, I am convinced their value in assisting an attack is overrated. When they are used to destroy crops which are meant for enemy soldiers, it is generally the civilians who suffer first and most as available food supplies are taken to feed the combatants first. Furthermore, once an area is cleared of foliage, it may be avoided by the enemy. The troops which would have operated in that area, however, will simply be deployed elsewhere, negating the supposed advantage.

Lastly and most importantly, I believe we must consider the very delicate psychological barriers existing in the world against chemical or biological weaponry and the repercussions of American use of tear gas and herbicides during the Vietnam war. As we indicated in our 1969 study, "by making them respectable after an almost complete international avoidance of them since World War I, the U.S. has made all chemical weapons more attractive in any future war. Once the barrier between conventional and chemical weapons is broken, it is difficult if not impossible to erect new ones which distinguish between categories of chemical weapons."

There are several reasons why chemical warfare would be attractive to many nations once international prohibitions against its use could be easily ignored. Such weapons are relatively easy to develop and comparatively inexpensive if a nation feels a need for a mass killer to improve its security. The U.S. has already made scores of countries aware of the potential surface advantages that chemicals seem to offer by training foreign military officers in the use of these weapons.

Smaller nations which are denied access to nuclear weapons could easily turn to CBW. Such weapons in the hands of smaller countries which would not hesitate to use them would offset in significant degree the advantage the U.S. maintains in industrial strength and conventional military firepower.

For the above reasons, I am persuaded that the U.S. should renounce the future use of irritant gases and antiplant agents in warfare and ratify the 1925 Geneva Protocol as it now stands and as it is interpreted by the other parties to the Protocol.

If the Administration were to agree to this, The Senate Foreign Relations Committee might move forward on the 1972 Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on Their Destruction. This could also lead to further progress at the CCD meetings currently going on in Geneva. The current session in which we are discussing a comprehensive agreement on chemical weapons is still stalemated, basically over two main problems. We are insisting on some acceptable means of verification that the terms of the convention would be carried out, and we are concerned about the difficulties in identifying and segregating specifically what chemicals would be considered weapons. In an effort to answer our concerns, compromise suggestions have been offered by a group of non-aligned nations and also by Japan. Although ratification of the 1925 Protocol and the 1972 Convention would not resolve these problems, they might well increase optimism and sense of purpose at the talks and speed up progress in our summer session this year.

Regardless of what other nations do, today in 1974 the question raised in our 1969 study is still the main issue. Are the chemical weapons which our nation is still producing and storing necessary to our national security? Do they want the risks involved? It is my contention that they do not. I commend you, my colleagues on the appropriate Committee of the House for looking hard at this fundamental issue.

Thank you for your consideration.

U.S. ARMY: WHY WE NEED CHEMICAL WEAPONS

Mr. ZABLOCKI. I want to thank both of you for your excellent statements.

The mandate of the subcommittee, of course, is to deal with all matters affecting our foreign relations that concern matters of national security. Certainly, treaties—particularly those in the area of chemical and biological warfare—do affect our national security and our rela-

tions with other countries, and that is why this subcommittee has undertaken these hearings. It is not our intention to go into the pros and cons of chemical weapons. However, you stated rather flatly Mrs. Schroeder, that the Army Materiel Command is the "prime mover" for the binary program and the "prime roadblock" to an international accord on chemical warfare. Now that is really a rather serious charge, and I am wondering whether you are prepared to back up that charge with documentation or solid evidence?

Mrs. SCHROEDER. Well, I do have copies of different speeches that have been given. In particular I have one here from Colonel Dismore, Chief of the Chemical Branch in the Army, who is going around giving speeches about chemical weapons and why we need them. The interesting thing that I find as I read them is that as he goes through and says—well, let me give a quote here. Actually, probably the best thing to do would be to put this in the record.

[The information referred to follows:]

SPEECH BY W. E. DISMORE TO THE AMERICAN CHEMICAL SOCIETY SYMPOSIUM ON CHEMICAL WEAPONS AND U.S. PUBLIC POLICY; APRIL 1, 1974

CHEMICAL WEAPONS—A NECESSARY DETERRENT

I am very pleased to have the opportunity to speak to you today. The invitation was most welcome and the offerings of the previous speakers have been most interesting.

I have been told that these sessions are generally called to consider questions relating to "Chemistry and Society." Certainly the theme chosen for the symposium—"Chemical Weapons and U.S. Policy," seems to fit well into consideration involving the societal implications of the science of chemistry. Certainly, the dialogue between scientists concerning chemical warfare has been most lively since World War I, when gas warfare first attained notoriety. The range of this dialogue has been widespread and has led to many debates ranging from considerations of gas warfare as a "moral" approach to warfare, to the total damnation of gas warfare as a prime example of man's immorality.

I do not intend to debate the morality of chemical warfare—or of any other form of warfare. Rather, I would speak to you on the avoidance of war. I think we can all agree that this is an objective which we all support without reservation, but on what terms? Are we to resort to a form of isolationism turning our backs on the world and hoping that alone we can survive? I think not! We have heard it said many times that "No man is an island, entire of itself." In the world we live in, no nation can be strong or capable or healthy entire of itself. It may be that the current energy crisis has just provided us with an example of the wisdom of that statement. On life as a free nation depends upon others, and others depend on us. Now for some people that is the core not of our strength, but of our problems. But I don't believe this. Our links and our ties to other nations are part of our life's blood. If we don't protect our freedom—which is tied to the freedom of other nations—then we will be far the poorer.

This principle, that our strength and vitality as a nation are tied to our freedom in the world, explains a great deal about our security interests and about why we have an Army. We exist to protect that freedom, and we work to secure that freedom.

So if you ask why we have forces in being or why we have programs overseas—or why we are involved in so many programs that are not directly tied to the defense of the continent itself—it is precisely because our well being is at stake. We are not just defending someone else. We are not just doing someone else's job. We are protecting our security by recognizing that we must preserve the bonds and links that keeps us alive and prosperous in the world.

To insure the well-being of our country, we must be militarily prepared. We are not looking for war. In fact, by being ready for war, we may deter our enemies and prevent a war. But we must be ready to fight. As a result, the Army spends its time on remaining prepared, on demonstrating that we are ready.

What does preparedness mean? It means having the forces you need where you need them and when you need them. It also means that these forces must be capa-

ble. And it means that the strength of these forces must be credible, to our friends and allies as well as to our potential enemies if we are to deter war. Preparedness also explains other important parts of our Army's activities. It accounts for our concern that we have modern effective weapons systems with which to equip these forces and our interest in having a strong production and mobilization base on which we can build additional strength if needed.

Now if we develop and buy the right equipment, if we organize ourselves efficiently and position our forces properly and do all the other things right, we'll be well on our way to accomplishing the mission.

But what precisely is the Army's mission? Basically, it is to deter armed conflict and failing that, to resolve the conflict on terms favorable to the United States. For the moment, then, let us concentrate on the Army's primary role—that of deterrence. Webster's dictionary defines deterrence as "a state of mind" and the Army dictionary adds that the state of mind is "brought about by the existence of a credible threat of unacceptable counteraction." To achieve this "state of mind," then, a credible capability must exist. As I have already indicated, the Army spends a great deal of its time seeing that its strength is, in fact, credible. This is a highly complex and difficult task. Every actual and potential threat must be analyzed so that the best method of meeting the threat can be identified. Even when a decision has been made as to the best method for meeting the threat, consideration must be given to the degree of flexibility inherent in the selected response. Because our Army today is a small Army, at least in relation to the huge and distant missions we are expected to carry out, our success in these missions—in protecting our Nation's well-being—as well as the well-being of other free nations—depends not only on the skill of our forces but also upon the degree of flexibility built into them.

So far I have dealt in generalities about the goals and mission of our forces and about the type and quality of our overall capability to perform the mission.

Now I will direct my remarks to a small, but none the less important, part of our overall deterrent capability—chemical weapons. We have included these weapons in our armament to assist us in achieving our primary mission—to deter armed conflict—specifically to deter the use of chemical weapons in any conflict in which the U.S. is involved. If chemical weapons are used against us, then our policy is to have the capability to retaliate. (Of course, any use of chemical weapons by U.S. forces would first require. Presidential approval.) Keeping in mind that part of the Army's mission is to be able to resolve a conflict on terms favorable to the U.S. if deterrence fails, the maintenance of this capability to retaliate in kind supports our overall strategy of deterrence while bolstering the credibility of that strategy.

I have previously stated that while we seek to avoid war, we must be prepared to fight, even though the threat may not be to the continent itself. This is particularly true for the chemical warfare threat. Chemical weapons are not, and have never been considered strategic weapons by the U.S. However, as we meet our commitments overseas, we are placed in positions where we could be subjected to an attack with tactical chemical weapons. In these situations the initiator of chemical warfare could gain a significant tactical advantage over the defender if the defender does not have the ability both to protect himself and to retaliate in kind. Even if protective equipment is available and used by the defender he may still suffer a serious disadvantage in tactical mobility since his forces would be encumbered by the necessary protective equipment. With a retaliatory capability, he can subject the attacker to similar severe operational constraints attendant to warfare in a toxic environment.

I have also stated that one of our goals in providing an effective, credible fighting force is to provide for a flexible response to any threat. One of the primary reasons for the chemical capability is that it provides the President and the nation an option for limited retaliation to the use of chemical weapons which is below the nuclear threshold. This option thus provides for a greater degree of flexibility in conflicts involving chemicals while improving the credibility of deterrence against any use of chemical weapons.

A credible deterrent and defensive posture limits the temptation to an adversary which could arise if we were vulnerable to chemical warfare. In fact, many authorities attribute the exclusion of chemical weapons by Germany in World War II to a fear of retaliation by the allies.

I spoke earlier about threats and the difficulties inherent in their analyses. It is no secret that foremost among potential adversaries of the U.S. is the Soviet Union. It is there that the dominant threat of chemical warfare exists for U.S.

forces. The Soviet Union is considered to be well equipped in the chemical warfare area. Evidence of delivery systems, weapons development, protective systems, realistic operational training, and extensive civil defense training support the condition of a Soviet capability to operate in a toxic environment which exceeds that of the U.S. or our NATO allies.

It should be noted that Soviet influence is not limited to the European Continent but is felt world wide. The Vietnam War and the recent Middle East War are prime examples of conflicts in which vast amounts of Soviet equipment were available on the battelfield. In the Mid-East War, in particular, the quantities and sophistication of Soviet protective equipment provided Arab forces point up the degree of Soviet preparedness for chemical warfare.

I would be less than candid however, if I did not state that the question remains as to whether the Soviet capability represents their keeping open an option to initiate offensive chemical warfare operations or is merely a hedge against the possibility that the U.S. might use chemical warfare and is therefore a deterrent and a defensive capability.

At this point I think it advisable to note that the achievement of an effective, credible deterrent/retaliatory capability is not our only objective in the chemical warfare arena. We are committed to seek effective international restraints or limitations on chemical weapons and the U.S. has actively participated in discussions on this subject at the Geneva Conference of the Committee on Disarmament. The main problem to date has been the question of adequate verification, particularly as regards proposals for comprehensive limitations. We have focused on the relationship of possible verification measures to the scope of activities to be limited and we have been continuing our thorough reviews of how to achieve effective and worthwhile restraints. The issues inherent in CW are more complex than those associated with BW. Therefore, we feel that a CW treaty will require different measures than were achieved in the recently negotiated Biological Warfare Convention, which was the only new treaty in recent years which seeks to limit an entire weapons system.

It has been widely reported in the press that the Army has plans for a "new" chemical weapon called the binary weapon. This is essentially true, although the binary concept for the in-flight production of toxic chemical agents is not new and has been reported in the literature since at least the early 50's.

This literature has also dealt with the chemistry of the nerve agents. Accordingly, any competent organophosphorus chemist could prepare compounds analogous to the nerve agents including the binary components. However, I believe ballistically sound munitions-design to produce the exacting environment required for efficient chemical reaction of the binary components is technologically very difficult. Thus, the introduction of a binary munition into U.S. deterrent/retaliatory stockpile would not increase the access of small nations or dissident groups to technology necessary to produce a nerve agent. In addition, the physical access to U.S. munitions would not be enhanced by any introduction of binary munitions. The security afforded these munitions would be at least as great as current non-binary munitions—and the two components necessary to create a complete munition would be physically separated.

Before I leave the subject of binary technology, I feel it necessary to make a final point. Critics of the Army chemical weapons program have stated that regardless of the rationale for modernization, the selection of the binary weapon for this modernization was inappropriate because it is less effective on the target. Let me assure you that this is not true. Binary munitions design assures a target effectiveness equal to the non-binary rounds of equipment caliber or size.

I have indicated that the reason for this program is to provide for the modernization of our chemical stockpile. This modernization is limited to areas of obvious tactical uses in retaliation. Additionally, if our deterrent capability is to be credible, it must be effective and compatible with new all-purpose delivery systems. Although other technical approaches could have been selected for modernization, the binary approach offers several important advantages. These include improved safety during production, transportation and storage; no requirement for high-cost toxic production facilities; and simplified low-cost demilitarization procedures.

I feel that this approach to modernization is completely compatible with U.S. objectives in that the credibility of the U.S. deterrent/retaliatory capability will be maintained, while negotiations are underway to achieve effective and worthwhile chemical arms restraints. At the same time, the binary weapon

being developed by the Army could be readily demilitarized if a chemical arms limitation treaty requiring such was implemented.

In conclusion, as long as there is a threat of chemical warfare and it is judged to be in the best interests of U.S. National Security to have a deterrent and retaliatory capability to meet that threat, then the Army will continue to insure that it has the ability to accomplish the mission in support of those interests. Thank you.

Mrs. Schroeder. We all know that depending on your views, you can emphasize the pros or you can emphasize the cons. They emphasize the pros and leave out the cons, or they leave out the fact that we can develop a defensive capability against first use. Obviously they are not going around saying we are going to use these weapons first. I mean that is not the policy of the United States, thank goodness. They are not saying that, but they are saying we absolutely need them for a deterrent capability and for national security et cetera.

Now, because the Russians might use them first, or someone else might use them first——

BINARIES—NOT A NEW WEAPON SYSTEM

Mr. Zablocki. The argument also is proposed that in order to have a defense against chemical or biological warfare, there has to be research and development.

Mrs. Schroeder. The development experimentation in the area of binary weapons does not promise us any new weapon system, it is exactly the same weapon system, and they are probably even 60 percent less efficient than the current weapons we already have in the stockpile.

The main reason they want to go to the binary system is that the binary will use the same kind of shells and delivery vehicles that our current chemical arsenal has. The only difference will be that you will have two chemicals that by themselves will not be harmful, so the storage won't be so obnoxious to people.

In other words, people in my area do not like to have chemical weapons stored in their backyard.

Now, the main idea for moving ahead is not that it gives us a new system. It does not create a new kind. It is the same delivery system, the same problems as with the old one. The only thing is that the storage would be safer.

That is why I think that we should make it very clear where we stand on chemical weapons, because if we don't think we need them, why spend probably $1.5 to $2 million to just create at nicer way to store them?

RESEARCH AND DEVELOPMENT FOR DEFENSIVE CAPABILITY

Mr. Zablocki. I understand that, but it is also my understanding that as a member of the Armed Services Committee, you might be in a position to enlighten our subcommittee on the argument that they need to go into research and development for our own protection against chemical warfare.

Mrs. Schroeder. I think if they want to protect our troops against chemical warfare, we should be going in to the defensive capability of the mask, the clothing, and new ideas in that area, because if anyone uses them against us, it will be a surprise attack and we should have

developed some way to defend the people in the field. This is not like a nuclear attack where you cannot defend. You can defend against chemical weapons, and I think that would be the best way to do it.

We are not doing research and development in this area. I think anyone who would use them against us would surmise that since we have a stockpile, we intend to retaliate in kind, and therefore, they would be prepared to defend against our chemical weapons and they would be useless.

PROTOCOL DEALS WITH UTILIZATION, NOT STOCKPILING

Mr. ZABLOCKI. Mr. Dellenback, is there not some stockpiling of chemical weapons in West Germany? Does that not seem incongruous with their position as a signatory to the protocol, permitting military capability of chemical warfare to be stored in their country?

Mr. DELLENBACK. Well, Mr. Chairman; I don't know about the stockpiling so far as West Germany is concerned, but as you are fully aware, and in effect more aware than I, the 1925 protocol is not to be confused with the 1972 convention, nor with what is happening in Geneva at the present time. The 1925 protocol deals with utilization in warfare, and that is what is at stake in the 1925 protocol. It is only when you get into the question of the 1972 convention and what is happening in Geneva at the present time that you are in the question of production and stockpiling.

Mr. ZABLOCKI. We are at the moment concerned with the protocol.

Mr. DELLENBACK. Yes, but this protocol deals with utilization in warfare, and this is a point of distinction that was touched on by a member of the subcommittee that had to do with the utilization for riot control, because again the 1925 protocol does not speak to that. The 1925 protocol does not speak to the question of domestic utilization or crowd control within a country of course, it deals with utilization in warfare. Therefore, I must plead, Mr. Chairman, that I do not know whether or not there is storage in West Germany, but even if there were, this would not interfere with ratification of the 1925 protocol because that has to do with utilization rather than stockpiling or production.

Mr. ZABLOCKI. Of course, but a stockpile is not intended for any other purpose than utilization.

DISTINCTION BETWEEN R. & D. AND PRODUCTION

Mr. DELLENBACK. I was merely trying to speak to your question, Mr. Chairman. Actually as I referred to our paper earlier, I have very serious reservations that go a step beyond, you see, what you are now asking me about, as to whether or not we should be having this kind of thing at all.

A distinction should be made between doing research and development and going into production. Research and development is largely for preventive purposes—so we understand what is happening in a field and can countermove if we have to countermove in at some time—moving from the R. & D. into production. I don't think we should go into the question of stockpiling, which of course follows if we go into production.

I was trying to stay with the answer to the chairman's question in making the distinction between the 1925 protocol which I think the Senate could move on very soundly no matter what we had at the present time in connection with West Germany or all our dealings with NATO. If anybody should use that as an argument why we cannot go forward with the 1925 protocol, and the chairman of course is not doing that—you were merely raising a question about that—if anyone should use that question as an argumentation, I just don't think it is relevant to the question of whether we need to ratify that 1925 protocol, or whether we could indeed do so, sir.

Mr. ZABLOCKI. I am in perfect agreement with the gentleman for the purpose of record.

Mr. Biester.

NUCLEAR FALLOUT—A TYPE OF CW?

Mr. BIESTER. Mr. Chairman, I also appreciate that last answer very much.

I wonder if we can go off on a slight tangent here, and that is a question which has been going around in my mind as we talked about ratification by countries. I noticed that Germany ratified in 1929. To what extent is radiation from nuclear weaponry a form of CBW warfare, or is it just simply an extension of an explosive device?

Mrs. SCHROEDER. I would have to say that not being a scientist I don't know.

Mr. BIESTER. I am not either.

Mrs. SCHROEDER. Here we look at custom I guess, and generally we have considered one area being strictly chemical and the other being nuclear detonation and its fallout.

Mr. BIESTER. Sort of it being a side effect.

Mrs. SCHROEDER. Yes.

Mr. BIESTER. I think that is probably the way I look at it also as a nonscientist, but it seems to me that Germany, a signatory to this document in 1929, was by 1941 engaged in the rapid process of developing nuclear weaponry which certainly as one looks at it has to have some kind of side effect beyond simply an explosive impact, and a side effect which seems to me partakes some degree of nature of chemical or biological warfare. At least it gets into what I would call the gravamen of the offense of sweeping chemical warfare.

WHEN MANKIND IS THREATENED

Also as I reflected on the fact that Germany signed in 1929, that even though they did not resort to CBW warfare directly in the field as far as I know, when man turns vicious he has been ingenious enough to construct fairly deadly means in his own way.

Mr. DELLENBACK. If I may make a brief comment on that, Mr. Biester, I would just say two things in passing. First, without in any way approving what Germany did or didn't do, we were not party to the contract and, therefore, we are not in a position to claim breach by the other side because we had not even done that as of that time, nor even as of this very much later time. I would suggest that that was one possibility and that it would follow that our capacity to really do some-

thing about it would be much better if and when we have ratified it. Then we can move insofar as future action is concerned.

In addition to that, it would seem to me extremely important that we take steps which go beyond this one, that we not settle for the 1925 protocol as to where we go. I think, as you said, when mankind is threatened he seems to do devious things. Although we might feel chemical weapons would not be valuable, and might even prove counterproductive, if we are really threatened, we might lash out with something that we have even though it won't work. Better not to have it if we know in advance that it will not work.

CHEMICAL WEAPONS NOT THE MOST EFFECTIVE

Mrs. SCHROEDER. I think too we have to keep in mind that we are not giving away our ultimate weapon either. I think so often we forget that chemical weapons are not the only thing we have, so it is not that we are suddenly left naked standing as a nation.

Mr. DELLENBACK. Would you yield?

They are not even our most effective. It is a question of whether they are not negatively effective.

Mr. BIESTER. I am not disputing any of that. I am pointing out it is probably not even worth the time that we spend on it. When Hitler decided to construct nuclear weaponry, that an earlier German Government had signed or ratified this protocol did not at the crunch point make much difference to him.

NATO POSTURE: ONE OF DEFENSE

Now with respect to the NATO countries themselves at the conference that was attended by Mrs. Schroeder, what was the view of the individual NATO countries at that conference in terms of either stockpiling or forward deployment?

Mrs. SCHROEDER. Well, with respect to NATO countries, there is only one that has forward deployment, that is, Germany, and I don't think they are really happy about it, they have the same problem that we have in Denver—even if you want it, not here. Thank you very much. We are glad you share with us, but we can do without it.

The NATO countries have decided that in the nuclear, biological, and chemical warfare area NATO's posture will be one of defense, not offense, which I think is very commendable. In other words, they would hope to defend against someone else using them, they would not consider using them first. So I think that they would much prefer masks, ponchos, anything of that kind, and having training missions and all sorts of things. This could be very, very effective, and again for several reasons in all three of these areas.

In the nuclear area, however, as you know, we have not got that kind of defense system, but that is their posture.

Mr. BIESTER. That is helpful to know.

Mr. Chairman, I don't have any other questions. I simply would like to commend both of our witnesses here in not only being well conversant with the issue but also having strong feelings about moving our country in what I hope most of us regard as the right direction.

Mrs. SCHROEDER. Thank you.

Mr. ZABLOCKI. Mr. Fraser.

DIFFICULTY OF ADMINISTRATION'S POSITION

Mr. FRASER. Thank you very much, Mr. Chairman.

The problems that we have before us, just to get us to a common starting point, are No. 1, the ratification of the 1925 Geneva protocol banning the use of chemical agents in warfare, and then, second, the ratification of the 1972 convention on the manufacture and storage of biological agents, and as I understand it, the latter is hung up on the former.

Mr. Dellenback, that is what I get from your statement, the fact that we have not been able to come to an understanding with the executive branch on the inclusion of herbicides and perhaps tear gas, or whatever the general name is for that and this has in turn caused some difficulty with the 1972 convention.

Mr. DELLENBACK. Well, it is my understanding substantially, Mr. Fraser, that as you point out, the 1925 protocol has been in the Senate's hands several times, most recently for several years, and the 1972 convention is being hung up because of disagreements with the administration that relate to the 1925 protocol. And then going forward at all in Geneva at the present time with chemical warfare is hung up because of these couple of issues, and failure on the part of the administration to go along with what most of the other nations of the world feel about herbicides and tear gas.

NO DOMESTIC ADVANTAGE TO CW STOCKPILES

Mr. FRASER. Let's move to the next matter, which is the proposal to ban the production and the storage of chemical agents, the subject of current and I should say—the preceding 3 or 4 years activity in Geneva.

The arguments both of you make lead one to the conclusion that whether or not we had an agreement, the United States could afford to stop production and end our stockpile. In other words, it seems to me that you are arguing that given the nature of chemical warfare and its inherent difficulties and its relationship to other weaponry, including nuclear weapons, the United States gains no real advantage by having a chemical warfare stockpile, and that, therefore, there is no real reason for us to go forward with our own capability whether or not there is an agreement at Geneva.

You don't say that in your statement—maybe you do—but in any event that is the conclusion I think one would come to in reading your statement.

Mr. DELLENBACK. If I may, I would like to reply. I think that is the thrust of our 1969 study, Mr. Fraser, so far as chemical and biological weaponry is concerned. Now for purposes of international agreement I think there would be great value in the nations of the world reaching agreement on this particular thing, but I would make the point substantially as you put it.

Mr. FRASER. Well, this then leads me——

Mrs. SCHROEDER. I was just going to say I would certainly concur, and I think one of the things that concerns us about the binary is proliferation. What do we want? If our allies want to buy them and stockpile them, aren't we really then being responsible for proliferating these kinds of weapons?

IS BINARY LETHAL?

Mr. FRASER. This leads to my next question, which is the question of U.S. action to continue development, testing, and procurement of a binary type weapon. Is that lethal gas, does it come under the term "lethal gas"?

Mrs. SCHROEDER. No; it is not until the components combine.

Mr. FRASER. I know, but once combined is it not disabling?

Mrs. SCHROEDER. Yes.

Mr. FRASER. In any event, the question whether we should go forward with that then is, in a sense, not a matter for us to consider in this committee except as it may have arms control implications. It is a matter the Armed Services Committee should be examining. In other words, you are arguing on the merits that we don't need it. You are also arguing that there also needs to be action in the arms control field. But I want to refer again to the Armed Services Committee. Are they looking at this question of whether we need it?

Mr. DELLENBACK. If I may, an Armed Services Subcommittee last fall had 2 days of hearings on this particular matter, and since then I have heard of no action taken by the Armed Services Committee whatsoever. But the Armed Services did take a 2-day look at this in the Congress at the question of what should be done in chemical and biological warfare.

Mr. FRASER. Generally.

Mr. DELLENBACK. Yes.

CONGRESSIONAL ATTEMPT TO CUT BACK BINARY PROGRAM

Mrs. SCHROEDER. Let me say in our Research and Development Subcommittee there is going to be an attempt to cut back the binary program that is in the fiscal year 1975 budget, and whether it will be successful or not I am not sure, but they are looking at it very seriously. It is not anything new. It will have the same delivery. It will go as far. In fact, it will be 60 percent less effective. So if we want exactly the same stockpile we have now, we would have to produce just that much more, and I believe many people feel it is an obsolete weapon in search of a use, some way to justify itself, and I question if that is the kind of thing we should be spending money on when there are so many areas we are behind.

BINARY DEPOLITICIZES CW STOCKPILES

Mr. FRASER. Its principal advantage, then, of the binary gas is that until the two compounds are combined they are relatively safe to handle and store?

Mrs. SCHROEDER. That is right. They figure people like us would not be concerned because constituents would not object to it in their back yard.

Mr. FRASER. So in addition to detoxifying the chemical warfare stockpile, binaries also depoliticize it.

Mrs. SCHROEDER. That is right. I must admit too, I have to take my hat off to the Army for, I think, one of the great common sense decisions of the year, in that they finally decided to detoxify the stockpile in Denver that obviously no one else wanted it, and it was one Federal

installation everybody felt their district could do without; no place to put it, nobody wanted it. They decided to detoxify it in place, which I think also is an admission in part that maybe it is not quite as vital as we once thought it was.

COMMITTEE MANDATE

Mr. DELLENBACK. I would hope, Mr. Fraser, as you consider the question of the real thrust of this subcommittee, however, that you not shift the burden to the Armed Services Subcommittee. I commend this subcommittee and the chairman for what you are doing.

Yes, I think there is a very real military question—as a lay military man, not as a professional military man—but as one like you charged with responsibilities of setting policy in this field, Our study led us to the conclusion that I alluded to earlier that this was not a sound weapon, but I think it goes way beyond that. I think it does have major impact in the relationships with other nations because in so many ways what we do or don't do as leader of so many nations has impact on them.

I think what we do or don't do in that protocol will be critical. What we do or don't do in the convention will be critical, so it is very much within the province of this committee. I feel very strongly on that, sir.

U.S. POSITION SUSPECT

Mr. FRASER. I think one of you, Mrs. Schroeder perhaps, underscored this: we have been unable to produce a U.S. position at Geneva: on top of that we now appear to be embarked on a new program of development and procurement. Thus the U.S. position becomes even more suspect.

Mr. DELLENBACK. I would agree with that.

Mrs. SCHROEDER. Yes.

Mr. FRASER. I would too. I was at Geneva just about the time we were being denounced rather soundly for our unwillingness or inability to do anything.

Mrs. Schroeder, you think that our arms control director is doing a good job. He may be, but where is the evidence?

Mrs. SCHROEDER. Well, I think he can't go it on his own. He has to have a mandate.

Mr. FRASER. That is the problem though. I mean, wherever the constraints are coming from, how can you say he is doing a good job in the absence of any results?

EFFECTIVENESS OF ACDA

Mrs. SCHROEDER. That is true, he must have infinite patience because it must be very hard to keep the morale of his troops up year after year when our response is no response; our response is: that is a very interesting proposal, however, we don't see any on-site verification. That is how it boils down. So he must be very patient.

Mr. FRASER. Are we going to give him high marks because he's patient?

Mrs. SCHROEDER. No. I think his problem is trying to get the administration to focus on it. The SALT talks have had much more glamor.

The MBFR has had much more glamor. The bilateral approaches in the State Department have had much more glamor, and this has gotten pushed to one side. I think it is very difficult.

Since the Geneva protocol and the 1972 convention have not been ratified it really looks like the United States just does not pay much attention to multilateral agreements. So we keep pushing, but no one listens.

Mr. FRASER. Do you know that he is pushing?

Mrs. SCHROEDER. I think so. I think he is trying hard.

Mr. FRASER. That is an inference we may draw at least?

Mrs. SCHROEDER. Yes.

Mr. FRASER. As to whether he can come up and tell us that or not—thank you, Mr. Chairman.

Mr. ZABLOCKI. Mr. Harrington.

NUCLEAR WAR MORE "THINKABLE"

Mr. HARRINGTON. I am just spectating, Mr. Zablocki. I appreciate it. I just wanted to get informed and I appreciate being able to hear the witnesses.

I would like to throw out just one question which may not be entirely relevant, that is in keeping with the Secretary's generally expressed preference for suggesting to the world, this year, that he is going to make nuclear war somewhat more thinkable. Was the Secretary asked anything analogous to this as far as chemical weapons are concerned in his appearance before the Armed Services Committee? I am referring now to Secretary Schlesinger's comments made earlier this year.

Mrs. SCHROEDER. No, not that I recall. Mainly we stayed on the nuclear aspects of that discussion, and everybody was so overtaken by that new approach we didn't get back to the chemical.

Mr. HARRINGTON. Thank you.

Mr. FRASER. Mr. Chairman.

Mr. ZABLOCKI. Yes.

Mr. FRASER. I forgot to say, and I don't do this as a matter of routine, how much I appreciate how much interest you are both taking in this matter. This is not pro forma. Without the kind of support and interest and knowledge that you are bringing to this our job would be considerably harder.

Thank you very much.

Mr. DELLENBACK. We appreciate that.

Mr. FRASER. Thank you.

SUPPORT OF ACDA

Mr. ZABLOCKI. Mr. Fraser had asked you, Congresswoman Schroeder, what input the ACDA and its Director, Dr. Fred Ikle had. You responded that ACDA could do more if the agency had the active support of its own State Department. That would imply that the State Department is not only not supporting but probably hindering ACDA in its efforts. Have you any evidence of the State Department's activities in this connection?

Mrs. SCHROEDER. Let me say I have not had any direct evidence, and I feel a little—I think we should have them speak for themselves

on this. Even in the Armed Services Committee, many people would like to pretend like they didn't exist.

It is like a conflict of interest. We cannot have these people giving away the wonderful weapons system. We are not interested as a committee very often in hearing from them either, and I sympathize with them because the door has been shut in their face—at least that is what I hear as I drift around, and it is hearsay.

I think the best would be to ask the doctor himself.

Mr. ZABLOCKI. You can be assured we will ask the State Department, the Defense Department, ACDA, and any other agency of Government who has any views or any input on this question.

PREVIOUS HEARINGS ON CBW

I failed to mention, and I apologize for it, when I welcomed you, Mr. Dellenback, that on November 18, 1969, together with our colleage Don Fraser and the Honorable Richard D. McCarthy of New York, you were the leading witness in a similar series of hearings that we started on that date on "Chemical-Biological Warfare: U.S. Policies and International Effects." At that time you gave excellent testimony.

I want to say that both of our witnesses today have demonstrated their sincerity and their insight on a very difficult and complex issue, one that we are going to pursue, and we are in accord with your concerns.

Mr. DELLENBACK. If I may, Mr. Chairman, the issue is not only complex, as you have so well said, but it is extremely important. I really do commend you, Mr. Chairman, and the members of this subcommittee for taking this issue which is one of the most critically life and death issues that this Nation and this world are going to be dealing with, and seriously trying to do something about it. You deserve commendation for it.

Mr. ZABLOCKI. Thank you very much for your very generous comment.

SUPPORT FOR PROTOCOL RATIFICATION

In 1969, when we held the hearings, we thought we would jar the Senate loose. Our hope did not materialize. Nevertheless, we don't give up easily. We waited 5 years, but we are trying again. This time I note that there is wider support among our colleagues.

I would like to ask unanimous consent to include at the beginning of the hearings where I refer to the sponsors of the resolutions introduced into Congress, the names of all the principal sponsors and cosponsors of House Resolutions 679, 710, 712, 713, and 752.

Again, thank you, Congresswoman Schroeder and Congressman Dellenback, for appearing before this committee.

Mrs. SCHROEDER. Thank you very much, Mr. Chairman.

Mr. DELLENBACK. Thank you.

Mr. ZABLOCKI. Since I am advised there will be another caucus, the committee stands adjourned until 10:30 instead of 10 tomorrow when we will hear the three distinguished private experts: Dr. Matthew Meselson, Dr. Julian Perry Robinson, and Mr. Alan Pittaway.

[Whereupon, at 12:10 p.m., the subcommittee adjourned, to reconvene at 10:30 a.m., Thursday, May 2, 1974.]

U.S. CHEMICAL WARFARE POLICY

THURSDAY, MAY 2, 1974

House of Representatives,
Committee on Foreign Affairs,
Subcommittee on National Security
Policy and Scientific Developments,
Washington, D.C.

The subcommittee met at 10:40 a.m. in room 2172, Rayburn House Office Building, Hon. Clement J. Zablocki (chairman) presiding.

Mr. Zablocki. Today is the second in a series of hearings by the Subcommittee on National Security Policy and Scientific Developments on the U.S. Chemical Warfare Policy.

Yesterday the subcommittee heard testimony from interested Members of Congress. Because he was ill, Representative Wayne Owens, chief sponsor in the House of the legislation, which is the subject of these hearings, was unable to be present, and we are, therefore, pleased to welcome him here this morning.

Following Congressman Owens' testimony, we will hear three distinguished private witnesses with expert knowledge in the field of chemical warfare: Dr. Matthew Meselson, Dr. Julian Perry Robinson, and Mr. Alan Pittaway. They will present their testimony as a team, and we will question them as a team.

Congressman Owens, if you will please take the stand and present your testimony.

STATEMENT OF HON. WAYNE OWENS, A REPRESENTATIVE IN CONGRESS FROM THE STATE OF UTAH

Mr. Owens. Thank you, Mr. Chairman.

I appreciate very much your kindness and thoughtfulness in letting me postpone by one day my testimony. I am very pleased, of course, that your committee has decided to devote considerable time to an examination of the current status of this Nation's chemical warfare policies as proposed in legislation which I and my cosponsors have introduced.

U.S. MAINTENANCE OF CW STOCKPILES

Mr. Chairman, I first became involved in this matter last June when the U.S. Army proposed the transportation of surplus chemical nerve agents from Denver's Rocky Mountain Arsenal to the Tooele Army Depot in my district. Although this particular matter was resolved after hearings before the Armed Services Committee in October by a change in Army plans, permitting destruction of these materials on-site, I was curious and concerned as to how such an issue could recur again. Following congressional investigation on chemical and biologi-

cal warfare in 1969–70, it appeared that these programs were well under control.

I began questioning U.S. chemical warfare policies in terms of (1) identifying some threat to our security which required the continued maintenance of nerve agents in our stockpiles and (2) the processes which were governing the changes and modifications in our chemical warfare programs which continually led to such issues as had emerged again in 1973 in the Denver area.

After examining the chemical warfare stockpiles in my district and at Denver through visits and a series of briefings on intelligence estimates of the basis of the threat, I analyzed the deterrence policy associated with the maintenance of stockpiles for retaliation. I then studied the history and development of the World War I Geneva Protocol on Biological and Chemical Weapons and the current negotiations at Geneva on more complex arms control measures.

I examined the current research, development, and test and engineering programs, and the proposed procurement by the Army of the first portion of binary chemical weapon. Even after all of this effort on my part, I have to admit that I still retain the same feeling of uncertainty regarding the justification for our continuance of an offensive chemical warfare program.

HISTORICAL BASIS OF CW POLICY

The whole basis for our offensive chemical warfare policies seem to stem from the use of chemical weapons in World War I. The revulsion which the world exhibited following the use of gas in that war produced a number of proposals which led eventually to the Geneva Protocol of 1925. From those early efforts for arms control we passed into another major war, when the United States warned our enemies that if chemicals were used against our forces we would retaliate in kind—and in fact, we actually had chemical agents in the European theater so that our forces could carry out this promise if necessary.

Although there is no doubt that the enemy had chemical agents at least as potent as ours, and as we later learned, more effective than anything we had, there was no use of chemical warfare agents during that war. Historians disagree as to whether the threat of retaliation was the real deterrent to the use of chemicals in that war, but the point I want to make here is that I think that our current posture on maintaining chemicals in stocks for retaliatory purposes was reinforced by the military position taken at that time.

CW PROGRAMS SINCE WORLD WAR II

Since World War II, we have gone through several distinct phases in our chemical warfare programs. We built nerve agent plants in the 1950's because we learned that the Germans had nerve agents during the Second World War, and it was obvious that at least one other major nation, the Soviet Union, obtained this same information. Because this chemical was so obviously superior as a nerve agent to anything that was in our arsenal at that time, it seemed perfectly logical to replace our mustard and phosgene stocks with the more toxic nerve agent.

Following the stockpiling of nerve agent in the 1950's there was a reduction in activity. Then the late 1950's and early 1960's brought on renewed Army activity for more diversified and sophisticated weapons for disseminating the nerve agent, and an attempt to get the other armed services involved in chemical warfare programs. This renewed activity seems to have been the result of justifications presented to the Congress that the Soviet Union had an enormous and significant capability in chemical warfare which could only be countered by increasing the chemical weapons in our own inventory. Even a reluctant Navy became involved in the chemical warfare program for a short time.

The background of information I collected can probably be summarized quickly by the general observation that the justification for maintaining a stockpile of nerve agent weapons is based on an estimate that a potential enemy maintains a stockpile of nerve agent weapons. This fits into the general military philosophy that each weapon must be countered by a similar weapon.

HOW RELIABLE IS U.S. INTELLIGENCE

The obvious questions which must be asked about this philosophy are the hardest to get answered. How reliable is the intelligence that the Soviets or any other potential aggressor intend to use the chemical agents—first—in any future war? And what are the exact situations in which such an attack can best be prevented by the threat to retaliate if such weapons were used? Does our intelligence about Soviet chemical warfare order of battle indicate that they fully intend to utilize nerve agents as a part of their offensive effort or are they developing the same posture we have enunciated because they know we have these weapons in our inventory? One of the most important is: Does the threat to retaliate with nerve agent weapons if chemicals are used against our forces in war really constitute the best deterrent to the initiation of the use of chemical weapons in any future war? How effective would a nerve agent attack in retaliation be against an enemy with a superior capability to defend and fight in a toxic environment? Wouldn't the use of nerve agents against a nuclear armed force actually trigger the necessity for a nuclear response if the attacked forces were to effectively resist such an attack?

These questions have been discussed with many individuals: Active duty military officers, retired military officers, and civilian experts. I have observed many interesting reactions. In one instance, a military officer—Carl Cunningham, former Chemical Corps officer, now with Midwest Research Institute in Kansas City, and has been involved in studying arms control and disarmaments—who was strongly in favor of the need for a retaliatory capability before retirement, became convinced after studying the problem in retirement that such a capability really does not constitute an effective deterrence among nuclear armed forces.

ARMY CHEMICAL CORPS STRONG BACKER OF CW

The strongest proponents for maintaining chemical weapons are to be found in the specialty Army Chemical Corps. These individuals must obviously support an established doctrine. Yet a considerable

amount of indifference can easily be identified in the military among other branches of the services. Discussions about the intelligence indicates that we really do not know very much about the Soviet's offensive capability, and that we have placed a great deal of emphasis on our knowledge of their defensive capability.

I do not pretend to have gained all of the information which may be available on this subject. I have not been able to talk with individuals who have played the war games in which retaliation with chemical weapons has been one of the integers in the equations. I doubt that these games prove a great deal in any event. Certainly, some sort of evaluation about the effectiveness of herbicides in Vietnam must have been completed in order for our commanders to be convinced of the need for such use. And yet, I am certain that those evaluations did not predict the end result of such use. At least I hope that no decisions were made to use herbicides with a full understanding of the end results as we now know them to be. If that should be the case, then we are in trouble.

DOES STOCKPILING CW SERVE AS A DETERRENT?

The net result of my effort over the last 9 months is to leave me still in doubt about whether this Nation should, in today's political and military environment, continue the same 50-year-old doctrine of maintaining a chemical warfare stockpile as a deterrence to the use of chemicals.

What particularly disturbs me in this evaluation is that the United States does not seem to come out well in the equation. We do not seem to have the capability in place in Europe to effectively and immediately offer the same level of retaliatory capability which a potential enemy probably could offer if the enemy actually did plan a first strike with chemical weapons. The logistics of shipment and maintenance of such a capability would be quite complicated. This seems to indicate that the retaliatory threat is miniscule in comparison with the first strike threat.

Second, either quantitatively and/or qualitatively, however we interpret General Abram's recent statements about the Soviet defense equipment captured in the recent Mideast war, we are well behind the Soviets in our own defensive capability. If an enemy should utilize chemical agents against our forces, it would be under circumstances which would require the most effective and immediate response which we are capable of delivering. This would mean immediate escalation to the use of tactical and strategic nuclear weapons in order to prevent defeat. What, then, is the basis for maintaining a stockpile of chemicals for retaliation only?

DANGER OF INTERNATIONAL PROLIFERATION

These preceding comments bring me to a matter of immediate concern. Several nations in the world already have a nuclear capability. It is only the expense of the technology which has prevented other nations from achieving a similar capability. We have been fortunate thus far that more nations have not developed the capability to manufacture and deliver nerve agent munitions. The Army proposal to

adopt binary munitions as a system of weapons to replace our current nerve agent munitions offers the potential risk that more nations may decide to develop chemical weapons. If the limited monopoly on nerve agent weapons is lost, we may see greater use of such weapons to the overall detriment of world peace.

Some of the limited uses of chemical weapons since World War II, such as the reported use in Yemen and Iraq, against countries with no capability of defense, and fortunately only on a limited use basis, might expand, and we might see a new and terrifying weapons escalation. Since the binary offers the prospect of manufacturing and handling nerve agents without as great a risk as is associated with current weapons, the reduction of the danger, as well as the practical elimination of detection of manufacture, may be the very incentive needed to induce proliferation of chemical weapons among smaller aggressive nations.

We have an opportunity, it seems to me, in the current negotiations on arms control at Geneva, to exploit more intensively the only avenue currently available to limit the development and manufacture of chemical weapons. It appears to be in our best interest to encourage such an arms control treaty to which all nations would be required to adhere. If, by our example, we indicate that our intentions are to update and modernize our own stockpiles at the very time such negotiations are going on, it seems to me that we are not supplying the leadership example of which we are capable.

THE BINARY WEAPON: A TACTICAL ADVANTAGE?

One of the responses given to me when I suggested that we might profit from delaying the development of the binary weapon was that we should not weaken our chemical weapons posture before any treaty is negotiated. The principle inherent in such a comment is that the binary weapon is in some way so tactically superior to existing chemical weapons that we should offer the elimination of the binary system as an incentive in negotiations. This is not necessarily the position in which we find ourselves. At least one prominent analyst—Julian Perry Robinson—who will be testifying before you during your hearings, has completed an analysis which indicates that the binary weapon may not be as effective a chemical weapon as is the current system it is designed to replace.

The real advantage to the binary weapon seems to be safety in shipment and storage, not its tactical advantage. Therefore, the suggestion that we may be negotiating from a position of weakness if we delay the binary does not appear to be valid. In fact, from a negotiating viewpoint, it appears to me that it would be more of an expression of good will and serious intent if we were to indicate that we were postponing modernization of our stockpiles until we learned just how serious other nations were about reaching treaty terms which are acceptable to us—including the need for acceptable verification.

Another argument about adoption of the binary, which has been offered as further support of the need for maintaining a stockpile, is that it really is a small price to pay for a weapon which just might come in handy some day. I suppose in terms of the massive total Department of Defense budget, this year's request for $5.8 million to

33-749—74——4

begin procurement of the binary is small. But small budgets have the potential to grow into larger budgets.

COST OF CW PROGRAMS

Six months ago I requested from DOD, within the limitations of security and available information, a summary of data on what we have spent on our lethal chemical weapons programs to date. I am providing the results which arrived just recently as enclosures for your use, if you desire to include these data in the record of hearings. The review supplies all of the cost information which I was able to obtain from the Department of Defense on the lethal chemical programs.

Mr. ZABLOCKI. Without objection.

[The information referred to can be found in the appendix.]

Mr. OWENS. I think that you should keep in mind when you have had an opportunity to examine these data, that information on nonlethal systems such as herbicides, riot control agents, incapacitating agents, et cetera, have not been included in these estimates. I have had a summary of these data prepared in tabular form which may be of greater interest to you, and these tables are also included for your examination. A few specific comments may be appropriate at this time.

It appears to be definite that $5.8 million has been requested in the fiscal year 1975 budget to begin procurement actions for the binary system. I cannot ascertain whether any separate funds have been requested under military construction funds to modify the facilities at Pine Bluff to incorporate a production line for the 155 millimeter shell. Of particular interest are the current and anticipated costs totaling $9.115 million for fiscal year 1974, and $24.139 million for fiscal year 1975. (The $5.8 million for procurement of the binary is included in the total for fiscal year 1975).

Looking back at these small costs, we find that our lethal chemical warfare programs have cost us $132.641 million to date for R.D.T. & E.; $158.149 million for facilities; $214.137 million for procurement; $4.190 million for a special transportation of weapons for Okinawa to Johnston Island; and operating costs of $18.959 million. These estimated costs give us a total of more than $528.076 million, just for our lethal agent programs.

EARLY CW PROGRAM COSTS UNAVAILABLE

Please keep in mind that it is probable that substantial costs for programs prior to fiscal year 1964 are not available, classification prevents the inclusion of other cost estimates, and the nonlethal chemical agent and all biological programs have been left out of these estimates. I believe it is safe, therefore, to assume that the cost of our chemical weapons program has not been insignificant.

In addition to our investment to date, we will be asked to spend an additional $1 to $2 billion for the total replacement of present stockpiles with the binary system. There are estimated costs available which indicate that it will cost $200 million just to buy artillery shells to replace approximately 20 percent of current stockpiles. The total replacement of all munitions with the binary munitions could cost five

times that much, or $1 billion. Add to that the costs of demilitarization and detoxification of existing stockpiles and weapons research and development and the figure could reach as much as $2 billion.

Accordingly, I do not believe that we can consider the chemical deterrence policy as not warranting comprehensive examination because it costs the Nation so little to maintain a "just in case" weapons system.

CONCERN FOR U.S. DEFENSIVE CAPABILITY

One final observation which I would like to make before my summation. I am quite concerned about our defensive capability. Even if we are successful in negotiating a treaty on arms control, I do not believe that it will be absolutely safe to assume that we may never be attacked with chemical agents. Even if we reach the conclusion that the use of chemical warfare agents is not the best deterrence posture—that is, other weapons may be just as or more effective for retaliation—we must still insure that our forces are provided with the best defensive capability possible. I feel very strongly that such a defensive capability in itself constitutes an effective deterrence to interest in a first strike chemical attack.

But we must assure ourselves that the Department of Defense has indeed assigned a sufficiently high priority to development and maintenance of a defensive capability that it is effective. I have already written a letter to the Secretary of Defense about my concern in this area, and I have asked him to insure that our military forces are being provided with the very best of defensive equipment and that training in the use of chemical defense equipment provides a realistic and high state of readiness. This posture should not be neglected whatever decisions are eventually reached about overt chemical warfare policies. For your information, I am also enclosing a copy of the letter which I sent to the Secretary of Defense on this matter, which I ask be made a part of the record.

Mr. ZABLOCKI. Without objection, it will be made part of the record.

[The letter referred to follows:]

APRIL 29, 1974.

Hon. JAMES R. SCHLESINGER,
Secretary of Defense,
The Pentagon, Washington, D.C.

DEAR MR. SECRETARY: The issue of arms control for chemical weapons has been reopened for negotiation at Geneva. It is my understanding that the United States is still committed to the task of achieving an effective chemical arms control policy. As I am sure you are aware, I view the adoption of binary chemical weapons by the United States Army as a contradictory position with regard to announced U.S. arms control efforts. This chemical warfare issue has been examined briefly by the House Armed Services Committee and will receive an even more intensive examination during the hearings before the House Foreign Affairs Subcommittee on National Security Policy and Scientific Developments which are scheduled to begin May 1. During this same period, the House Appropriations Committee is being asked to approve funds to begin production of the binary chemical system.

This letter is intended, however, to discuss with you another issue of concern which I have about our chemical warfare posture. When I first became involved in this problem last year, as a result of the munitions destruction controversy in the Denver area, I began my examination by asking DOD as well as other appropriate agency personnel to explain the rationale in support of the U.S. position of retaliation with chemical weapons as a deterrent policy. I found it difficult then, as I still do, to see the justification for such a policy. Since the possible eventual abandonment of a chemical warfare offensive capability does

affect the security of the United States, I continued my investigations to determine what the side effects of any change in policy might be. As a result, I have also developed a concern about the capability of the armed forces of this country to defend and operate effectively in a toxic environment. When I learned that General Abrams had stated in public his belief that Soviet chemical warfare defensive equipment, captured during the October Mideast wars, was superior to American equipment, my concern was intensified. I am sure that this same equipment was available during the Six-Days war and it appears we may already have lost some six years of time. I was aware, of course, as a result of the very abbreviated intelligence made publicly available that our analysts believe that the Soviets are exceptionally well trained and equipped to fight in a toxic environment. In fact, the intelligence analysis about the Soviet defensive capabilities can be, and frequently is, interpreted to mean that this operational capability is evidence that the Soviets are fully prepared to conduct chemical warfare—therefore our need for deterrence. A less frequently cited basis for this defensive capability is the obvious deterrence value to the Soviets of their strong defense. I cannot help but wonder whether we have taken our own defensive needs as seriously.

When I asked about the attitudes of other European Nations on chemical warfare deterrence policies, I learned that some of our allies view the capability to defend and fight in a toxic environment to be just as effective a deterrent to the use of chemical weapons as is the capability to retaliate in kind. The English, in particular, seem to favor this position. Such a posture seems to offer many advantages of deterrence without the disadvantages which the threat of an offensive capability seems to offer to world stability. In fact, without the ability to defend effectively, an invitation may actually be extended to an enemy to attempt a chemical attack, particularly if the attacked Nation has no other retaliatory capability to offset the chemical threat. Although the United Sates does have alternative retaliatory weapons in the form of enormous investments in both tactical and strategic nuclear weapons, I do not believe that we should neglect at this time our chemical weapons defensive posture.

Because of my concern about the implications of being able to defend against chemical weapons, whatever the outcome of the issue of adoption of binary weapons or negotiations at Geneva, I want to encourage you to consider the need for strengthening the chemical warfare defensive research of the United States military forces. I also want to suggest that we may need to increase significantly the training of our military forces to operate in a toxic environment so that such operations become as routine a part of our own military exercises as our intelligence implies is the case in Soviet training. Although I am not as familiar as I should be with our training in this area, I suspect, from the few comments I have heard, that our military forces receive only a cursory introduction to the use of chemical defense equipment. It also appears that our progress in development of more effective defense equipment may be under a lower priority than is our emphasis on the development of new types of toxic agents. Certainly, if the observations made by General Abrams are accurately reported, we have not effectively used knowledge which apparently has been available for about six years.

If the Conference of the Committee on Disarmament at Geneva can continue and reach a successful recommendation for a chemical arms control treaty, and I believe that we can lend support to these negotiations by delaying adoption of the binary chemical system, I think that we will have taken one more step toward world peace. I am not so naive, however, to believe that such a treaty would instantly eliminate the hazard of a possible attack on our military forces with toxic chemical agents. As noted before, I have heard very logical arguments that a strong defensive posture has even more justification as a deterrence and would thus strengthen the tendency to comply with any treaty.

I realize that intensive training in the use of chemical defense equipment and the accelerated development and test of better defense equipment requires not only manpower and money but also related facilities. It is my opinion that a portion of the proposed funds for the binary system could be used more appropriately to support an expansion of our RDT&E effort on chemical defense as well as for improved training. The Dugway Proving Grounds, as has been frequently stated by Army spokesman, is one of the few isolated military facilities in this country where work with toxic or realistic simulant agents and training in the use of defense equipment can be conducted in comparative safety. It would seem to me, therefore, in the best interests of our national security, to expand our defensive

efforts and that Dugway can continue to contribute to the national defense, along with its other major tasks, by expanding operations in the general area of defense and training under realistic chemical warfare conditions. As I have said on a number of occasions, I have no intention or desire to weaken the defensive capability of this Nation. I do believe in fact that we may not be doing all that should be done in the area of chemical defense. I simply have difficulty in accepting the need to commit extensive resources to a new offensive chemical system to support a deterrence policy which does not seem warranted in today's political environment or in light of current weapons capabilities.

I would appreciate hearing any comments which you can offer in regard to my suggestions.

Sincerely,

WAYNE OWENS.

NEED TO RATIFY GENEVA PROTOCOL

Mr. OWENS. In conclusion, my recommendations are:

First, I believe that the Geneva protocol should be ratified just as soon as possible. Any further delay in declaring our position on this issue only reduces the credibility of our efforts at negotiations in Geneva.

Further, I believe that the protocol should be ratified without the exclusion of herbicides and riot control agents as outlined in the President's letter of transmittal to the Senate. Since the biological convention is linked to our chemical negotiations in Geneva, I believe that this convention also should be ratified just as soon as we have ratified the Geneva protocol.

Second, even though the proposed initial procurement of binary weapons is only a relatively minor item in the total chemical warfare program, I believe that this procurement can be delayed without detriment to our current defensive posture and with the added advantage of supporting the negotiations at Geneva.

TOTAL PHASEOUT OF CW

Third, serious consideration should be given to phasing out chemical warfare altogether, just as we were able to eliminate biological weapons from our stockpiles in 1969. At Geneva on Tuesday of this week Japan offered just such a draft treaty to prohibit production and phase out stockpiling of chemical weapons.

If it is eventually determined that chemical weapons can be phased out as no longer necessary, then the Nation will have avoided what could become a considerable added cost of weapons systems if the binary procurement continues as programed.

Fourth, I support the concept of a strong defensive capability as a viable deterrent to the use of chemical weapons. To this end I have tried to encourage a higher priority of effort in this area, and I recommend that the Congress indicate its interest in a similar increase of priority on this topic.

INFLUENCE OF CONGRESS

Finally, the recommendations of the committee have in the past, and can now have, an influence in both the Congress and the administration positions on this topic. In the final analysis, however, it is through our actions in both Houses, as we support or reject appropria-

tions for various programs proposed by the military, that we can be most influential.

I hope that my own contributions to this evaluation will have been helpful to the Members in understanding this issue so that the decisions we make can be cast in the framework of the total implications of the problem. We seem to avoid open discussion of this topic because of a background of supersecrecy and general abhorrence of the subject. We cannot stay out of the issue since ultimately it is through our actions as Representatives that we reject or support these policies. We should not imply consent through silence.

Mr. Chairman, thank you for this opportunity to participate in your evaluation of this subject. I look forward with great interest to hearing the observations of the other witnesses you have asked to testify.

Mr. ZABLOCKI. Thank you for a very excellent statement.

RATIFICATION OF GENEVA PROTOCOL SENATE PREROGATIVE

At the very beginning I would like to ask you a technical question as to the difference between your House Resolution 679 and that introduced by Congressman Dellenback, House Resolution 710. Your first resolve states that "It is the sense of the House of Representatives that the Geneva protocol of 1925 banning the first use of gas and bacteriological warfare be ratified immediately."

Now as you know, ratification is a prerogative of the Senate.

Mr. OWENS. That is right.

Mr. ZABLOCKI. The Senate may take offense at such a directive. Would you find it probably beneficial if we would not take as strong a language in the final version? Have you any deep concern about your first resolve?

Mr. OWENS. No. I did feel it was appropriate, Mr. Chairman, that the House go on record as supporting immediate ratification without the exclusion on herbicides and riot control agents, but any wording which would preserve the separation of prerogatives of the two Houses would, of course, be satisfactory with me just to allow us to express our concern.

Mr. ZABLOCKI. Indeed in the second resolve you do have such an expression.

Mr. OWENS. I have no strong feeling in that regard, Mr. Chairman.

Mr. ZABLOCKI. Thank you very much.

RELIABILITY OF U.S. INTELLIGENCE ON FIRST-USE

May I ask you to answer the rhetorical question you pose in your own testimony. Just how reliable is our intelligence that the Soviets or any other potential aggressors intend to use chemical agents first in future wars?

Mr. OWENS. Well, Mr. Chairman, that is a very difficult question to answer. I have had briefings by a number of different agencies and as the chairman is probably aware, or will be made aware during these hearings, there are indications that there was some defensive equipment, chemical warfare equipment which was discovered, I understand, recently in the Middle East. I simply must assume that it is

relatively reliable, but I have no way of knowing, I guess, Mr. Chairman.

I personally don't see why they would ever use it, but they might.

Mr. ZABLOCKI. Do you have any feeling as to the extent our country should prepare a defense against chemical warfare?

Mr. OWENS. Well, the country which uses the chemical weapons first gets all the advantage of surprise. I have had briefings which spell out much of the information, I suppose classified, which spell out the true extent of our defensive capability which General Abrams has recognized publicly that we really are not very well prepared to defend ourselves against a first strike, but it does seem clear that we have not prepared ourselves very well at all to defend, which seems foolish because at the same time, as the chairman knows, we have said we will not strike first, and yet we have no defensive capability.

If there is a serious threat, then it seems like we are very much unprepared—very must unprepared.

OTHER NATIONS COULD MANUFACTURE BINARIES

Mr. ZABLOCKI. You have rather strong views about the binary program that the Department of Defense is initiating, am I correct?

Mr. OWENS. That is what the lawyers would call a contention against interest. The testing is being done in my district in Utah, that is right, Mr. Chairman.

Mr. ZABLOCKI. Well, do we have any evidence, or as a member of the Armed Services Committee, do you have any evidence that other nations, including the Soviet Union, are entering into binary programs?

Mr. OWENS. I guess I cannot answer that, Mr. Chairman. I don't know.

Mr. ZABLOCKI. Since it is such a relatively simple process I would expect that other nations, even some of the smallest nations, could enter into binary chemical programs.

Mr. OWENS. That is part of the great threat, that it would appear that that would make the capability readily available to any small country to have some kind of an exotic middle weapon system.

Mr. ZABLOCKI. And a very difficult process to try to police?

Mr. OWENS. That is right. That is my understanding. That is certainly my observation.

Mr. ZABLOCKI. Verification would be almost impossible.

Mr. OWENS. I think so.

Mr. ZABLOCKI. Thank you, sir.

POSSIBLE VERIFICATION METHODS

Mr. OWENS. Well, I might say, if I could, Mr. Chairman, there are a lot of theories of verification as to whether we need inspection or not. There are some economic theories of verification put forward by different experts that you could verify, and this is, I guess, currently being talked a great deal about at Geneva.

There are ways that you could verify some of the chemicals required in the binary system that the Government could follow where they were being used in different countries, and the countries then if they had agreed to furnish information as to why a certain chemical—and I am very sorry, I am very much a nonchemist, and I cannot remember

the chemical, but there are theories that the use by the manufacturer of the binary system intended could be verified economically rather than requiring onsite inspection. Now I don't know whether that is what the chairman was getting into or not.

Mr. ZABLOCKI. I understand that there are various methods of verification. It is my understanding, however, that it is compounded as far as the possibility of complete verification because of the binary process.

Thank you very much.

Mr. du Pont.

GENEVA NEGOTIATIONS

Mr. DU PONT. Thank you, Mr. Chairman.

Mr. Owens, there are actually three sets of negotiations that have gone on in Geneva, one of which has to do really only with biological warfare. So setting that aside, there is the 1925 protocol which you recommend that the Senate ratify. That protocol simply renounces the first use of chemical warfare agents, and presumably that would be no problem to us. But the current negotiations are concerned with R. & D. production, and stockpiling of chemical weapons. It is not quite clear to me from your testimony what your position is on that set of negotiations, and what position we ought to take as a country in regard to those negotiations.

Mr. OWENS. The present negotiations going on with Dr. Ikle of the Arms Control and Disarmament Agency. I am very much impressed with the doctor's statements on what this country ought to do as regards chemical warfare, stockpiling, and manufacturing. He has said, and his assistants have said, as recently as 3 or 4 weeks ago, that this country wants to do away with its chemical warfare system.

At the same time, as I have pointed out, I think the Army wants to spend $6 million to start the procurement of a whole new system. I strongly agree with Dr. Ikle, and strongly support the present negotiations.

I am impressed that Mrs. Schroeder I think testified yesterday, and while I didn't hear her, I understand that she had visited those Geneva negotiations and is convinced that we are stalled for almost no purpose over there, that we have not been willing to put forward a program.

DISTINCTION BETWEEN CHEMICAL AND RIOT CONTROL AGENTS

Mr. DU PONT. How would you distinguish between chemical agents and riot control agents such as tear gas?

Mr. OWENS. I am not sure I understand the gentleman's question.

Mr. DU PONT. Well, if we agreed not to manufacture or stockpile chemical warfare agents, would we thereby be prohibited from manufacturing and stockpiling tear gas? If your answer is no, how do you define a chemical warfare agent in such a way as to exclude tear gas?

Mr. OWENS. Well, I have been impressed by the recent report of which the gentleman is probably aware having to do with herbicides and riot control in Vietnam, which was a disaster, they didn't work at all.

Mr. DU PONT. Not in use in Vietnam. Tear gas by police, for example, in riot situations in the United States.

Mr. OWENS. Well, our negotiations, of course, deal with external use in war, not with local situations.

Mr. DU PONT. I understand that, but if we agreed in Geneva to ban the production of chemical warfare agents, would that not ban the production of tear gas within the United States?

Mr. OWENS. The gentleman asks the question I had not thought too seriously about, I suppose. My position would be that we should agree not to use them in international war. They should not be excluded from the Geneva protocol. But if they are—and I believe they are of some use locally—I suppose that that would be an exemption for domestic use. External use, of course, is the point of the Geneva protocol.

Mr. DU PONT. Well that certainly is the point of the 1925 protocol, and I am glad you agree that we would want to put some kind of an exception in whatever agreement we reach so that we would be able to use them if necessary internally.

Mr. OWENS. I don't have an opinion, though I might say to the gentleman as to how effective they are in this country. I understand that most people think they are quite effective at times, so I am not opposed to that.

ON THE ADEQUACY OF THE DEFENSE BUDGET

Mr. DU PONT. In your fourth point in your summation you say you support the concept of a strong defensive capability as a viable deterrent to the use of chemical weapons. What additions to the Pentagon's defense budget would you favor in order to encourage this defense if we eliminated the use of chemical weapons?

Mr. OWENS. I have no knowledge of how much money it would take, and I don't even have a lot of details on seriously how unprepared we are, but I did have a couple of briefings on the statistics which are classified from both the CIA and the DIA, and I would think that the subcommittee might be interested in hearing those statistics. It is, I think, of concern that we are so unprepared defensively.

I cannot answer. I have no idea how much money that would cost.

Mr. DU PONT. Your emphasis then in your testimony is on defensive capability relative to chemical weapons being used against us and not defensive capability generally?

Mr. OWENS. I am sorry.

Mr. DU PONT. In other words, you suggest in your testimony that if we renounce the use of chemical warfare agents we can make up for that or be defensively secure through the use of other weapons systems, and we don't need a chemical response to a chemical threat.

My real question is, what kind of capability are you talking about? Are you talking about nuclear retaliation capability or traditional forces capability? Do you feel that the defense budget as currently drawn provides adequate retaliation so that chemical warfare agents need not be used?

RETALIATION CAPABILITY

Mr. OWENS. Well, except in the area of defensive capability—that is, defensive capability against chemical warfare—it appears to me

to be adequate. I am suggesting that if Russia in the European theater—twice I have had very long discussions with a number of people at the Pentagon to explain how it is, what kind of a battle plan, a game plan, that would allow us to use chemical warfare in retaliation, and I am at a loss. They cannot explain it to me, and I don't know whether that has something to do with my understanding capability or their explaining capability, but for the life of me I can't see how we could use chemical warfare defensively.

First of all, we are never going to use it in this country.

Second of all, we would use it in Europe if it was used.

Third, we have pledged ourselves against the first use.

Fourth, we know they are much better prepared against it than we are in defensive clothing. They obviously would be dressed to defend themselves against a retaliation in kind before they attacked us, so our retaliation of a chemical agent would have no effect whatever. The retaliation either of massive conventional weaponry or nuclear weapons would both be much more effective and, therefore, it seems to me very much a better way. Of course, it would seem to me that is a much better deterrent than the chemical warfare deterrent.

Mr. DU PONT. One final question. In your research you have not come up with any figure as to what you think it might cost to provide us with a defensive system against chemical warfare, the clothing and so forth?

Mr. OWENS. No. I have written a letter. I wrote it just 3 or 4 days ago to the Secretary of Defense, in essence asking that point among others which I have asked to be included in the record, but I don't have the information.

Mr. DU PONT. Thank you very much.

Thank you, Mr. Chairman.

Mr. ZABLOCKI. Mr. Fraser.

Mr. FRASER. Thank you very much, Mr. Chairman.

CW OFFENSIVE CAPABILITY UNNECESSARY

Mr. Owens, if I understand the thrust of your statement, the main point you are making is that we don't need an offensive capability in chemical warfare, and that you have that view whether or not we are able to agree in Geneva on a ban on the production or stockpiling of chemical agents.

Mr. OWENS. Yes. I am submitting to the subcommittee that that is what we ought to consider, I believe it to be true.

Mr. FRASER. I must say that I am persuaded by your argument on this. As long as the United States has the capacity, as it does, to destroy any country in the world in 15 minutes it would seem that that is probably a more effective deterrent than a chemical agent retaliatory capability.

A defensive capability—being able to protect against the effects of an attack by chemical agents—is not so useful from a deterrent point of view—since our deterrent lies in our larger military posture—but is simply prudence, insuring that units are not put out of action by an attack of this kind.

Mr. OWENS. Exactly. If our military intelligence indicates that there is a threat severe enough to require that we have not just one but two nerve gas systems, and we have no real defensive capability, it

seems like to me that there is a step missing there, and for some reason we are not making much sense in our policy.

Mr. FRASER. So that we ought to have more choices than massive retaliation. We also ought to be able to protect ourselves at the outset?

Mr. OWENS. It would seem to me that is right, sir.

RESEARCH NEEDED IN DEFENSIVE MEASURES

Mr. FRASER. Aren't we likely to encounter the argument that we cannot very well maintain adequate capabilities to defend ourselves against an attack using chemical weapons unless we engage in extensive research and development of potential agents? In other words, it will be argued that we cannot very well protect ourselves unless we know the full range of potential problems that we might encounter from an adversary who had not abandoned research and development, and perhaps production?

Mr. OWENS. It would obviously take significant research to determine what is needed to defend, what chemicals you would have to defend against obviously. I think that is true.

Mr. FRASER. So in any event we probably would be left with some form of our research program which would embrace the identification of potential threats.

Mr. OWENS. Whatever is needed to provide us with that necessary information, yes.

Mr. FRASER. I find your statement very thoughtful and I appreciate your initiative in this.

Mr. OWENS. Thank you very much.

Mr. FRASER. You've been very helpful to the committee.

Mr. OWENS. Thank you.

Mr. ZABLOCKI. Mr. Biester.

RATIFICATION WITHOUT RESERVATIONS

Mr. BIESTER. Thank you, Mr. Chairman.

I also wish to thank the witness for his testimony. I apologize to the witness for not being here throughout all of his full statement. And perhaps you may have covered this in that statement, and if so I will ignore the question.

Mr. OWENS. All right.

Mr. BIESTER. With respect to our adherence to or ratification of the Geneva protocol, do you think that we should ratify it with reservation or without reservation? I noticed that many of the countries have ratified with either one or two sort of boilerplate reservations based upon the action of potential enemies. What is your thought on that?

Mr. OWENS. My recommendation is that it would be ratified without reservation on the use of herbicides and riot control agents.

Mr. BIESTER. Without those reservations.

U.S.S.R. SUPERIOR DEFENSIVE CAPABILITY

Secondly, I am wondering in terms of the escalation of the gravity of military conflict where we can agree we put certain kinds of warfare, particularly I suppose in the question of land warfare, bullets having

I suppose let's say a level of gravity A or 1, and strategic nuclear weaponry having the highest gravity. Where would you set artillery? Where would you set chemical or biological warfare? Where would you set disabling gases? Where would you set lethal gases in that graduation?

Mr. OWENS. The gentleman asks very touchy questions for a nonmilitary civilian.

What I am trying to say is that if we are attacked with chemical weapons by the only country we know has them, namely the U.S.S.R., we also know that they have much superior defensive capability, clothing, and if we fire back with the nerve gas it is not going to do any good, but if we fire back with bullets or artillery that will penetrate the clothing.

I don't mean to step aside on the gentleman's question, except I don't regard chemical warfare as having any real impact if we are not going to use it in first strike. Of course, I would never urge that we use it as first strike capability, but it just seems like to me it does not make any sense.

Mr. BIESTER. Well, aren't we assuming in that answer a rather stable situation in terms of research and development?

Mr. OWENS. In terms of perhaps our being able to develop a chemical warfare which could penetrate their clothing?

Mr. BIESTER. Or they ours.

SOVIETS CONCENTRATE ON CW DEFENSE

Mr. OWENS. Well, we know they spend a lot more time apparently on their defensive capability. I suppose that the gentleman is suggesting that maybe we could build a better chemical weapons system which could penetrate their clothing. I doubt it. It is relatively easy to protect against now. I doubt it, but I am not a chemist.

Mr. BIESTER. Neither am I.

Mr. OWENS. Ask Mr. Meselson when you get him up here. I bet he would give a much more intelligent answer on that than I would.

Mr. BIESTER. One of the difficulties I have in setting the biological warfare is it seems to me that it rises to the nuclear warfare in terms of gravity.

Mr. OWENS. Setting aside biological warfare?

Mr. BIESTER. Yes.

Mr. OWENS. I am not sure I understand the gentleman's questioning. Set aside biological warfare. We didn't think we would get to control it, we thought it was so foolish. It would be impossible for us to control and that others would be unable to control it, and therefore I suppose without requiring any verification at all we set it aside. Chemical weaponry is much more controllable obviously than biological weaponry.

LEVELS OF POTENTIAL HAZARD

Mr. BIESTER. Well, I appreciate your answers because what I am trying to do is to see in my own mind the levels of potential hazard both to other human beings and ourselves involved in the use of any of these kinds of weapons, and it seems to me that when we talk about biological warfare we are talking about something at least as hazardous as general nuclear warfare if biological warfare gets out of con-

trol. We are all doomed then. It is a weapon that ultimately turns against us, does it not?

Mr. OWENS. I am not sure what the gentleman's question is, but I think I agree with him.

Mr. BIESTER. It is not really a question. It is an observation. I think that what it leads me to get into is the whole question of perhaps nuclear warfare as well. I am just trying to think out loud with the gentleman about where we ought to set certain scales of violence and what their nature really is, and what the position of our society should be with respect to them.

I appreciate your testimony very much.

Mr. OWENS. I don't advocate lowering the nuclear shield to the level which you use nuclear weapons at all, but I am just saying that that is a massive retaliation, a massive deterrent. Chemical warfare is not a deterrent in my view, and that is what I am urging the committee to consider very seriously. It is truly an ineffective weapon system.

Mr. BIESTER. Thank you.

Mr. ZABLOCKI. Mr. du Pont.

TEST BAN AND THE PROTOCOL

Mr. DU PONT. I have one further specific question.

Assuming that we ratify the 1925 Geneva protocol without exception, and assuming further that traditional military action started in Western Europe, an infantry war, would it be your opinion that having ratified that treaty that we would be prohibited from the use of tear gas as a supporting weapon for infantry?

Mr. OWENS. If we ratified the protocol without the reservation, I would think so; yes.

Mr. DU PONT. Thank you.

Mr. OWENS. Thank you.

Mr. ZABLOCKI. Thank you, Congressman Owens. We appreciate your coming before the committee, and we wish you well.

Mr. OWENS. Thank you.

Mr. ZABLOCKI. Dr. Meselson, Dr. Robinson, and Mr. Pittaway, if you will please come forward. We will hear each of you together as a team.

Dr. Meselson.

STATEMENT OF DR. MATHEW MESELSON, HARVARD UNIVERSITY BIOLOGICAL LABORATORY

Mr. MESELSON. Thank you, Mr. Chairman.

The question I would like to discuss with you this morning is where should the United States draw the line against chemical weapons?

STANDARDIZED CHEMICAL AGENTS

The chemical warfare agents now standardized and stockpiled by the armed services are:

VX, a lethal nerve agent that kills when inhaled or when deposited on the skin.

GB, or the German Sarin, a lethal nerve agent that kills when inhaled.

HD, or mustard, a blistering agent that can incapacitate or kill.

BZ, an incapacitating agent that causes disorientation and irrational behavior lasting up to several days.

CS, a riot control agent which irritates the eyes, nose, and throat for periods generally lasting no more than a few minutes after exposure is ended.

Agents orange, white, and blue, herbicides for reducing vegetation cover and for crop destruction.

Our national policy strongly reaffirmed by the present administration, renounces the first use in war of lethal and incapacitating agents such as VX, GB, mustard, and BZ. Such chemicals may be used only in retaliation against a chemical attack initiated by an enemy. In contrast, we have not renounced the first use of riot control agents or chemical herbicides.

According to current policy, the distinction between incapacitating agents and riot control agents is that the symptoms of incapacitating agents persist for hours or days even after exposure has ceased, whereas the symptoms of riot control agents are more transient. These distinctions in definition and policy become crucially important as we move toward ratification of the Geneva protocol of 1925, the international treaty prohibiting chemical and biological warfare.

UNITED STATES ONLY MAJOR POWER NOT RATIFYING PROTOCOL

The Geneva protocol prohibits the use in war of "asphyxiating, poisonous, or other gases, and of all analogous liquids, materials, or devices" and "bacteriological methods of warfare." Nearly 100 nations are parties to the protocol, including all the major powers of the world, except the United States. In August 1970, President Nixon sent the protocol to the Senate for its advice and consent to ratification as one of several widely praised steps announced the previous year, "To reinforce our continuing advocacy of international constraints on the use of these weapons."

In presenting the protocol, the administration asked for acceptance by the Senate of the understanding that U.S. ratification would not apply to riot control agents or herbicides. After considerable testimony and discussion in March of 1971, the Senate Foreign Relations Subcommittee expressed to the President its strong support for the protocol but asked the administration to reconsider its position on riot gas and herbicides. The ratification process has been delayed as the administration reconsiders its position on where to draw the line.

USE OF TEAR GAS, HERBICIDES IN VIETNAM

Before the Vietnam war, our policy for riot control agents, then called tear gases and for herbicides was, in effect, one of first use. We had never used gas of any kind in combat since its general use in World War I. At the League of Nations, we repeatedly indicated our willingness to join in a prohibition against all types of chemical weapons, including tear gas. Even when the use of CS in Vietnam was first reported in 1965, Secretary of State Dean Rusk stated that CS would be used "only in situations analogous to riot control and not in ordinary military operations." But as the war intensified, this policy was eroded.

until nearly all the CS used was disseminated in support of ordinary military operations.

Before we had phased out herbicide use and sharply curtailed the use of tear gas in Vietnam in 1970, U.S. diplomats at the United Nations and elsewhere advanced the view that the Geneva protocol did not apply to these particular chemical weapons. Although we had not ratified the protocol and accordingly were not strictly bound by its obligations, we were sensitive to charges of violating its spirit and argued that using riot gas and herbicides represented no such violation. It soon became evident, however, that our interpretation of the protocol was not shared by the majority of nations. In December 1969, the U.N. General Assembly, by a vote of 80 to 3 with 36 abstentions, passed a resolution holding that the protocol prohibits the use in war of all toxic chemicals against man, animals, and plants. Only two nations, Australia and Portugal, joined us in voting against the resolution. At the time, Australia was engaged in the Vietnam war and Portugal was reported to be using herbicides against insurgent forces in her African colonies. Never had we been so isolated on an important vote at the United Nations.

DOMESTIC USE

I should mention here that neither the U.N. resolution nor the protocol itself have anything whatever to do with the use of herbicides in farming or other domestic pursuits, or with the use of riot control agents by police. By its terms, the protocol applies only to war, and no nation and no recognized authority has ever maintained otherwise.

During the Vietnam war, while tear gas and herbicides were still in use, it was impossible for us to determine objectively where we should draw the line against chemical weapons. Our experimentation with the use of these agents temporarily closed options which otherwise would have been open to us. But now that our forces are no longer fighting in Vietnam, our perspective can shift to the broadest and most meaningful view of our interests.

DETERMINING WHERE TO "DRAW THE LINE"

As with many treaties, the Geneva protocol may be interpreted either broadly or narrowly. It is fundamentally important to our interest that, in finally ratifying the protocol, we determine where the most durable line against chemical warfare can be drawn. We should begin with an understanding that a durable line must be clearly definable, with minimum ambiguity as to what chemicals are prohibited.

A distinction between riot control agents and incapacitants is obviously less clear and less likely to survive technological innovation than a simple rule against antipersonnel chemicals of all kinds in war. The search for more effective riot control agents has already produced an agent that could cause difficulties in this regard. The new agent, CR, can be considerably more long lasting in its effects than CS, yet there is interest in it as a more effective successor for CS.

INCAPACITATING AGENTS VERSUS RIOT CONTROL AGENTS

The case points to the difficulties that will arise as technology erodes any distinction that may now be formulated between incapacitating agents, which we have pledged not to use, and riot control agents. The chemistry and toxicology of possible agents defy easy or unambiguous categorizations.

A second requirement for a durable standard is that it be generally accepted by the parties to the protocol. Our insistance on excluding riot gas and herbicides can only perpetuate disagreement and breed ambiguity. Although a few nations have supported our interpretation of the protocol, it is evident that far greater consensus would be achieved if we were to accept the broad interpretation embodied in the 1969 General Assembly resolution.

A third consideration favoring a broad interpretation is that, to an important extent, the use of any chemical weapon stimulates technical and institutional interest in other chemical weapons, creating incentives and institutional pressures to erode the line.

SECURITY BENEFIT OF CW RESTRAINTS

The choice we face is between the military benefit that accrues from the option to initiate the use of riot control agents and herbicides in possible future wars, and on the other hand, the long-term security benefit of further strengthening the legal, political, and practical restraints against the proliferation and use of chemical weapons.

From this perspective, the stakes are incommensurate. Undoubtedly there are special battlefield situations in which riot control agents and herbicides have a certain utility. But the evidence indicates that this utility is only marginal. Riot gas is useless against forces with masks. Herbicides, even in jungle warfare, have failed to have a major and objectively demonstrable .value. These weapons would be of least utility in possible confrontations with our major adversaries.

On the other side of the scale, breakdown of constraints against lethal gas warfare could place in the hands of small or poor countries, and possibly even of terrorist groups, a formidable capability they do not now have to threaten ourselves and international security and tranquility in general.

If we can turn from preoccupation with the past, we will understand that our future interest lies in establishing a broad prohibition against all forms of chemical warfare. If the other nations of the world are willing to do so, we should be more than willing to break the impasse and lead the way.

Mr. ZABLOCKI. Thank you, Dr. Meselson.

Next Dr. Robinson, if you will proceed, sir.

STATEMENT OF DR. JULIAN PERRY ROBINSON, PROFESSOR, SCIENCE POLICY RESEARCH UNIT, UNIVERSITY OF SUSSEX, ENGLAND

Mr. ROBINSON. Thank you very much, Mr. Chairman.

I have prepared a written statement which discusses the interrelationships between nerve gas national security and international

security. It is rather long, so if it were acceptable, I would like to submit it for the record, and present a short summary.

Mr. ZABLOCKI. Without objection, the complete paper will be placed in the record at the conclusion of your oral statement, and you can summarize, Dr. Robinson.

URGENT NEED FOR U.S. POLICY ON CW

Mr. ROBINSON. Thank you.

As a foreigner, it is a very great privilege for me to be invited to appear before you. I hope the fact that I shall be commenting on what is essentially U.S. business will not be taken amiss. I have had the temerity to do so only because, in the area of chemical weapons policy in particular, action that is taken in this country cannot fail to have repercussions in Europe and elsewhere—perhaps very grave ones.

Having said that, I would like to plunge straight into these rather improper waters by stating that a comprehensive review of U.S. chemical weapons policy now seems to me, looking at things from the outside, to be urgently needed. The urgency arises primarily from the fact that the U.S. Army is on the point of buying a new range of nerve gas weapons, the so-called binary munitions.

The further this program proceeds, the more seriously will it conflict with current U.S. and European foreign policy endeavors on the chemical arms control front. These endeavors, it seems to me, offer out a prospect for improving security to a much greater extent than binaries ever can. I would very much hope that the binary program could at least be delayed to allow time for the arms control possibilities to be fully explored.

SECURITY DANGERS OF NERVE GAS

The security dangers of nerve gas, whether to the United States or to anyone else, are very real. A quart bottle of agent VX contains several million man-lethal doses and costs maybe $5 to manufacture in this country. To the extent that potential enemies may be attracted to so cheap a mass killer as a means for reducing their relative military inferiorities vis-a-vis the United States, and to the extent that the security of the United States depends upon relative military strength, the mere existence of nerve gas is a threat to U.S. security.

The threat shows up in two ways. First, the possibility that U.S. or NATO forces in Europe may be subjected to Soviet nerve gas attack on the battlefield. Second, the longer term danger to security in the possibility of nerve gas proliferation. So far, militarily significant stocks of nerve gas are limited to certain of the nuclear powers.

The immediate threat in Europe is real enough, although for reasons I have set out in my written statement I believe it has been exaggerated. U.S. policy for meeting this threat is to maintain a retaliatory nerve gas capability to serve as a deterrent. This is a policy, I might add, which has been consciously abandoned by my country. It is a policy which many people believe to require reconsideration.

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EFFECT OF "RETALIATING IN KIND" CAPABILITY

It is clear that a retaliatory nerve gas capability cannot deter in the normal meaning of the term. Protective equipments against nerve gas are widely deployed in Europe, both East and West, and they are now sufficiently good to remove most of the probability of a nerve gas attack inflicting major damage on troops alerted to expect it. The possibility of retaliation in kind may therefore have little influence on an enemy decision to use nerve gas; the enemy may well feel able to rely on protecting himself after he had reaped the benefits of a surprise nerve gas attack.

Thus the only significant effect of retaliating in kind would, it seems to me, be to force the other side into a full antigas protective posture. This could be important. The enemy would be forced to suffer whatever degradation of fighting efficiency may be imposed by respirators and protective clothing, a burden which will already have been forced on U.S. or NATO forces. This is the basis of the current Department of Defense belief in the deterrent propensities of its nerve gas.

The mode of deterrence envisaged is thus the rather unusual one of nullification of battlefield disadvantage during the period after the main damage has already been suffered. Thus, the threat to U.S. security which the capability is intended to meet is not the immediate threat of nerve gas. Rather, it is the threat to U.S. security of having some of its combat forces fighting in protective clothing and respirators.

DEFENSIVE CAPABILITY AS A DETERRENT

It needs to be reexamined just how important this threat is, and the extent to which it warrants the maintenance of a specific deterrent. There is substantial disagreement among chemical defense experts about the degree of degradation of fighting efficiency that may be imposed by protective clothing and respirators. Some U.S. experts speak of 20-percent degradation. Some European experts speak of a negligible degradation.

Possibly the disagreement reflects national differences in the priorities accorded to chemical weapons and to chemical defense. It is my impression, after talking with professionals on both sides of the water, that the Europeans take chemical defenses much more seriously, and particularly in the case of protective clothing, they are developing some very impressive equipment. Moreover, some policymakers in Europe believe that a sophisticated protective stance can act as a deterrent, and can do so more effectively than a retaliatory capability.

Thus, it is considered that the antichemical protection which is now available, or under development, in Europe can raise the weight of the attack needed to overcome it to a level where nerve gas attack is less cost-effective than conventional attack. That, it seems to me, is a real measure of deterrence.

NEW CW ACQUISITIONS COULD INCREASE PROLIFERATION

But neither a defensive nor an offensive capability can counter what may well be the most serious threat of all, that of nerve gas proliferation. Indeed, a policy of like-with-like deterrence may well aggravate the overall threat. Deterrence grows on mistrust, and mis-

trust distorts perception. A retaliation-only policy and capability might thus be seen as concealing, and providing for, a real policy that did not preclude first use. And if the United States now embarks upon an expensive and conspicuous new round of nerve gas acquisition, as it will do if the binary program goes ahead, how may potential enemies react?

On top of this there is the possibility that the spectable of the United States reequipping itself with nerve gas may lead countries which had previously kept out of this particular business to question their reasons for doing so. The United States is now very much the leader of technological fashion in the military world; and one has to remember that the new binary technology is likely to make a nerve gas capability more easily accessible to the poorer countries of the world.

For instance, in terms of capital outlay for agent production, U.S. experience is indicating a 25-fold difference, at least, between binary and nonbinary GB.

RISK OF PROLIFERATION

The security risk inherent in nerve gas proliferation is very great indeed. Suppose, for example, that a client Government of the United States decided to acquire nerve gas, and then used it to escalate a local conflict. Outside Europe there is very little antigas protection available, and under such circumstances the consequences of nerve gas employment could be mass destruction on a large scale. How conceivable is it that a direct superpower confrontation could not then be avoided?

Or look at it another way. What if a client Government of the Soviet Union did this? Could the resultant pressures for direct U.S. intervention be resisted?

One need look no further than the Middle East to envisage the enormous dangers to world peace of nerve gas proliferation. It is in everyone's interests to stop this from happening.

OTHER POLICY ALTERNATIVES

Because current U.S. chemical weapons policy seems to provide no way of controlling proliferation, and may even encourage it, there is a very strong case, it seems to me, for considering other policy alternatives. One such alternative is to rely, not on a counterthreat that may well be ineffectual, but on the prospects for removing the threat altogether—the immediate threat in Europe and the proliferation threat—by means of internationally negotiated chemical disarmament.

I get the very distinct impression that this option has not been fully explored by policymakers in this country, even though international negotiations on chemical disarmament have been going on, with U.S. participation, since 1968. Such advocacy for chemical disarmament as there has been within the administration has always been dampened by the traditional gut-reaction of the military against arms control measures, articulated in this case in the contention that chemical disarmament would be impossible to verify adequately.

It is, of course, the function and the duty of the military in any country to preserve national security as they conceive it. Whatever

the military has to say about security matters must therefore be assessed very carefully and with respect. And it is undoubtedly the case that, just as there is a risk to U.S. security in the continued existence of nerve gas stockpiles, so also would there be a risk if the United States got involved in international chemical disarmament that was incompletely verified.

ASSESSING BALANCE OF RISK

What is needed, therefore, is some form of logic which decision-makers can use to assess the balance of risk between the two alternatives.

In this connection, the U.S. delegation at the Geneva disarmament talks has made a very valuable contribution, even though at first sight it appears a rather negative one. The delegation has said that the United States is unable to accept currently proposed chemical disarmament measures because provisions for verification do not insure as much security as does the existing U.S. posture of like-with-like deterrence.

There is a logic implied in this which, if taken further, could well bring about a safe and worthwhile breakthrough in the negotiations.

What is being suggested in the U.S. position is that the assessment of risk should be between, on the one hand, the maximum degree of verification that is negotiable, and, on the other hand, the security benefits of chemical deterrence. Hitherto, the tendency in this country has been to assess the risks of incompletely verified disarmament without any reference at all to the degree of security provided by chemical deterrence.

BINARY PROGRAM MAY NEGATE CURRENT CW DISARMAMENT TALKS

Let me conclude by emphasizing the point once more that the chemical disarmament talks now running in Geneva offer out a policy alternative that may make much better sense than the existing policy on chemical weapons. A lot of time and study will be needed to examine fully the security implications and requirements involved in all this. But the time available for doing so is diminishing fast: it is being eaten up by the momentum of the binary program.

If the program is not checked, it may well foreclose entirely on the option of chemical disarmament. Procurement funds for binaries are contained, for the first time, in the 1975 budget. If these funds are appropriated this coming summer, it is possible that the chemical disarmament talks will fold up completely, whatever new negotiating stance is adopted by the United States or by any other delegation.

EUROPEAN CONCERN

We in Europe have a very real concern in all this. The binary program makes sense, from the immediate U.S. Army point of view, only if there are plans to preposition the new weapons in Europe—to move them into Germany soon after they have been manufactured. A lot of Europeans are going to be made very nervous by this. To us, the nerve gas threat is more immediate than it is on this side of the Atlantic; and, speaking for myself at least, I would prefer that all

avenues for countering the threat, including that of chemical disarmament, had been thoroughly explored before NATO is locked still more deeply into a posture of chemical deterrence.

A rush into binaries is not going to permit this; and it most certainly will not assist the negotiations that are currently going on in the broader, and still more important area, of tension reduction and force reduction in Europe.

Mr. Chairman, that is all I have to say. I have, incidentally, prepared a longer and more detailed analysis of the binary question which, if you are interested, I would be glad to submit.

Mr. ZABLOCKI. Without objection we will accept your submission and include it in the appendix.

Mr. ROBINSON. Thank you, Mr. Chairman.

[Dr. Robinson's prepared statement follows:]

PREPARED STATEMENT OF DR. J. P. PERRY ROBINSON, PROFESSOR, SCIENCE POLICY RESEARCH UNIT, UNIVERSITY OF SUSSEX, ENGLAND

My statement is concerned with the inter-relationships between nerve gas, national security, and international security. As a foreigner, it is a very great privilege for me to be invited to appear before you; I hope the fact that I shall be commenting on what is essentially United States business will not be taken amiss. I have had the temerity to do so only because, in the area of chemical-weapons policy in particular, action that is taken in this country cannot fail to have repercussions abroad, perhaps very grave ones.

I have been working in the field of chemical-weapons arms control for 11 years now. One of the conclusions which I would venture to put before you is that there appear to be fundamental inconsistencies between currently stated U.S. policy objectives on chemical weapons and current U.S. practice. The comprehensive reviews proposed in the legislation before you thus seem particularly appropriate.

One relatively minor illustration of what I mean is the fact that the present U.S. stockpile of lethal chemical weapons seems to be at least four times larger, in practical terms, than it was in 1945. I do not need to remind anyone that 1945 was the culminating year of an extremely hot war, conducted on a global scale under circumstances where chemical weapons had much greater security implications than they have today. The stockpile details are set out in the table over the page.

PRESENT SIZE OF THE U.S. LETHAL CHEMICAL STOCKPILE COMPARED WITH THAT AT THE CLOSE OF WORLD WAR II, IN TERMS OF TOTAL BATTLEFIELD TARGET AREA THAT CAN BE ENGAGED EFFECTIVELY [1]

[In square miles]

Agent type	1945	1974
Nonpersistent:		
Blood gases	[2] 60	0
Choking gas	[3] 180	0
Nerve gas	[4] 0	3,000
Persistent:		
Blister gases	[5] 2,000	[6] 0
Nerve gas	0	[7] 6,000
Total	2,240	9,000

[1] Calculated from contemporary munitions expenditure tables for a midrange set of weather conditions, and for comparable target effects. The base-line figures used for each agent (metric tons of agent per square kilometre of target) were as follows: CK—80; AC—50; CG—40; GB—2; H, HD, HT, L, and HN1—20; and VX—0.3.

[2] 11,400 tonnes of cyanogen chloride (CK) and 500 t of hydrogen cyanide (AC).

[3] 18,200 t of phosgene (CG).

[4] 15,000 to 16,000 t of sarin (GB).

[5] 83,400 t of sulphur mustards (H, HD and HT), 100 t of nitrogen mustard (HN1), and 20,000 t of lewisite (L).

[6] Mustard gas stocks still exist, but they have been declared obsolete and are being discarded.

[7] 4,000 to 5,000 t of agent VX.

Source: For the 1945 figures, the official U.S. Army history of the Chemical Warfare Service (Brophy et al, From Laboratory to Field, 1959). For the 1974 figures, my own estimates—which may be too low—derived from openly published DOD data: the derivation of the estimates is set out in App. 1 of my paper, "Binary Nerve Gas Weapons," mimeo, February 1974.

The Nature of the Nerve-Gas Threat to U.S. Security

Nerve gas is a threat to U.S. security, first because it exists, and second because potential adversaries are thought to possess it. A quart bottle of agent VX contains several million man-lethal doses. It costs maybe $5 to manufacture in this country. To the extent that potential enemies may be attracted to so cheap a mass-killer as a means of reducing their relative military inferiorities vis-a-vis the United States, and to the extent that the security of the United States depends upon relative military strength, the mere existence of nerve gas is a threat to U.S. security.

The Soviet Union is thought to possess militarily-significant quantities of nerve gas and of other chemical weapons. Like the U.S.A., the U.S.S.R. is believed to regard nerve gas as a battlefield weapon rather than a strategic one. It is in the damage that might be suffered by U.S. or NATO forces in Europe from Soviet nerve gas that the primary nerve-gas threat is considered to reside.

I am not privy to the intelligence appraisals in this area, and I expect that later on you will be hearing from people who are. But when you come to consider the magnitude of the threat, I do urge you to bear the following point in mind. It is my understanding that, although a certain amount of circumstantial evidence exists, hard intelligence data in this area are in fact extremely scarce. In any analytical field where there is a dearth of hard information, it is inevitable that the interpretations which can be made of the data that do exist will range between wide extremes. But in the chemical-warfare field, it is in the nature of things that only the more hardline, extravagant, assessments of the threat come to the attention of Congress in the normal course of events. Other assessments may be equally valid.

This point is discussed further in Volume II of SIPRI's *The Problem of Chemical and Biological Warfare* (Stockholm, New York & London, 1973). It is instructive to note that when the Secretary of the Army was asked to describe one aspect of the Soviet chemical warfare threat by a House Armed Services subcommittee last October, he did so by providing for the record what purported to be a quotation from this SIPRI volume. Since I was its author, I was aggrieved to discover the extent to which my words had been distorted by quotation out of context.

Factors That Act To Diminish the Immediate Nerve-Gas Threat

The process of deducing intentions from capabilities is a central part of threat assessment. But when applying the process to nerve gas, it must be appreciated that, interposed between the capability and the intention, there are several important constraints. These are not directly related to the capability, but they may have a profound effect on the intention. I would like to describe two of them.

The first is the fact that military people are in general not greatly attracted to nerve gas. It has been my experience in talking with professionals in several countries that those who see any over-riding merit in nerve gas as a weapon are in an extremely small, and uninfluential, minority. Nerve gas is as offputting psychologically to most military people as it is to most other people. It is a difficult weapon to use on the battlefield, requiring a great deal of special training, skill, special equipment, foresight, and joint planning. Above all, it is an uncertain weapon, dependent for success upon the precise level of enemy antigas protection and combat fatigue at the moment he is attacked. Few military people have been ready to accept these unpredictabilities and difficulties. Psychologically reluctant to do so, they have paid little attention to, or given much support for, the technological solutions to these problems which the R&D people show signs of providing. Thus, although large stockpiles of nerve gas exist in this country, the weapons have not been assimilated by the armed services. The stockpiles grew, and continue to exist, through an internal logic of their own, one that seems to have less and less to do with the real military world as time goes by. And I can see no good reason for supposing that the situation is any different in the Soviet Union.

The second major constraint arises from the fact that the very few countries today which possess militarily significant stockpiles of nerve gas also possess nuclear weapons. The roles which military force can play in the international relations of these countries are therefore dominated by—locked into—strategies and counterstrategies of nuclear warfare and nuclear deterrence. It follows that employment of nerve gas, by countries which are today in a position to do

so, cannot be considered in isolation from the nuclear background. Strategic analysts have attempted to do so, but it is not easy to develop convincing nerve-gas warfare scenarios for Europe in which nuclear warfare would not also figure, sooner or later. In other words, about the only circumstances under which nerve-gas warfare is conceivable are those in which the security interests at stake would be likely to precipitate nuclear warfare. Resort to nerve gas, because it is an internationally condemned and potentially outrageous weapon, would be evidence of intensely-motivated war aims, and therefore of the gravity of the security issues involved. Thus, the possibility of a nuclear response can scarcely fail to influence a decision to use nerve gas. This line of argument, I might add, was put forward by the British Defence Secretary to Parliament (on 6th May 1970) as the basis of the British Government's decision not to maintain a specific deterrent—were such a thing possible—against nerve-gas attack.

It could be, of course, that there was an element of opportunism in Mr. Healey's statement; and I am not suggesting that the nuclear constraint would invariably prevail, or that it should be relied upon. What I am saying is that the nuclear constraint must enter into any nerve-gas threat assessment in which intentions are deduced from capabilities; and I am further suggesting that its effect, taken in conjunction with the low level of nerve-gas assimilation described earlier, must be to reduce the magnitude of the overall threat of nerve gas to national security.

In summary, the proposition which I am putting forward is that, however much nerve gas the Soviet Union may have manufactured and deployed, the threat which it represents to U.S. security is not a major one. The same proposition holds for American nerve gas and Soviet security; indeed, it seems to have general validity for all the stockpiles of nerve gas that are known to exist today.

Proliferation: A Second, and Graver, Aspect of the Threat

Although this situation may be reassuring for the present, it would be the height of folly to regard it as a permanent one. It could change radically, and for the worse, in quite a short time. It only requires a lowering of the inhibitions about chemical warfare to accelerate the assimilation of chemical weapons, and any one of a number of factors to trigger off a process of proliferation that could carry nerve gas outside the constraining umbrella of the nuclear calculus. These eventualities could have a highly destabilizing effect, not only on the balance of constraints and incentives that dominate nerve-gas warfare, but also in more general fields of international relations.

Suppose, for example, that a client government of the United States decided to acquire nerve gas, and then used it to escalate a local conflict. There is very little antigas protection available outside Europe; and under such circumstances the consequence of nerve-gas employment could be mass destruction on a large scale. How conceivable is it that a direct superpower confrontation could not then be avoided? Or look at it another way. What if a client government of the Soviet Union did this? Could the resultant pressures for direct U.S. intervention be resisted? One need look no further than the Middle East to envisage the enormous dangers to world peace of nerve-gas proliferation. It is in everyone's interests to stop this from happening.

The basic point that I am trying to convey here is that nerve gas represents two quite different types of threat to U.S. security: on the one hand, the immediate threat in Europe, and, on the other hand, the future threat contingent upon proliferation. I have already suggested that the immediate threat is not a great one; I would now add the suggestion that the future threat is potentially very much greater—so much greater, in fact, that it ought to dominate United States policy-making in the area of chemical weapons.

A Critique of the Present Policy of Chemical Deterrence

Present U.S. policy on chemical weapons is to maintain a nerve-gas capability as a like-with-like deterrent or as a retaliatory option in the event of that deterrence failing. This policy cannot, it seems to me, provide any sort of counter to the proliferation threat; indeed, as I describe below, it may even aggravate it. It also seems to me to be questionable whether present policy is even an adequate counter to the immediate threat in Europe.

You will of course be receiving testimony on this point from people much more knowledgeable and experienced than I. But when you do so, I would urge you to keep the following considerations in mind.

(1) Because protective equipments are widely deployed in Europe, nerve gas cannot deter nerve gas by threat of massive retaliatory damage. Nerve gas could have devastating effects if used against forces caught by surprise in a low protective posture-carrying but not wearing respirators, not in protective clothing, with detectors and alarm systems not activated, etc. But any subsequent attack, by either side, would be directed against alerted forces; and present-day protective equipments and procedures can blunt most forms of nerve-gas attack. Moreover, new forms of protection are currently under development which may soon provide virtually complete protection against any nerve-gas attack that is logistically feasible on the battlefield. Because the side attacked with nerve gas could not therefore rely on inflicting major counter-damage by retaliating in kind, the possibility that he might do so would not be a strong deterrent.

The fact of the matter is that, after the initial attack, the only people that would suffer massive damage from tactical nerve-gas warfare in Europe would be noncombatant European civilians. Even if these people—and here I should be saying "we"—are provided with antigas protection, as seems unlikely, the protection would be of a much lesser order than that given to combat troops. Nerve gas is neither a discriminate nor a controllable weapon. Its effects cannot easily be confined to its immediate target, either in space or in time. The nerve-gas clouds set up by functioning munitions can drift long distances with the wind before becoming harmless. According to a current U.S. Army manual, a single Honest John or Sergeant warhead loaded with agent GB can create a hazard which, under some weather conditions, may extend for as much as a hundred kilometers downwind. And calculations have been made within the Department of Defense which indicate that, as a consequence of nerve-gas employment during one of the battlefield contingencies for which the United States maintains a nerve-gas capability, noncombatant nerve-gas casualties could be in millions, perhaps tens of millions.

(2) It follows from this that a sophisticated protective stance is a much more plausible and credible nerve-gas deterrent than is a retaliatory capability. Under circumstances where initiation of chemical warfare is both illegal and unlikely, there is more sense, therefore, in appropriating funds for chemical protection than for chemical weapons. Even now the point has probably been reached where NATO's antigas protection is capable of raising the weight of attack needed to overcome it to a level where a conventional attack would have better cost-effectiveness than a nerve-gas attack. That, it seems to me, is a real measure of deterrence.

(3) The notion that nerve gas can deter by threatening an equal mobility degradation requires more detailed substantiation than it has yet been given. The Department of Defense has put forward the argument that retaliation-in-kind would deter because it would force the enemy into a full protective posture; there would then be no significant disparity between the two sides as regards the degradation of fighting efficiency and mobility that may be imposed by protective clothing, respirators, and so forth. This argument is not, of course, about deterrence in the normal meaning of the term; it is about nullification of battlefield disadvantage during the period after the real nerve-gas damage has already been suffered. As a justification for U.S. nerve gas, it has to be considered alongside the facts (a) that there is no agreement among NATO experts that the degradation of fighting efficiency imposed by full protective posture, under temperate European climatic conditions, would indeed be militarily significant; and (b) of the increasing reliance that is being placed in Soviet Ground Forces on armoured fighting-vehicles and personnel-carriers equipped with CB air filters.

(4) There used to be a time when the offensive capabilities of nerve gas were unique among weapons, in particular as regards area-effectiveness and area-denial. But recent developments in blast, fragmentation, and flame weapons now provide a comparable area-effectiveness, and newly-developed mine warfare techniques provide a comparable area-denial capability. Moreover, protection against these weapons is considerably more difficult than protection against nerve gas. This means, first, an increase in the improbability of resort to chemical warfare, and, second, the availability of retaliatory options that make much greater military sense than the option of retaliation in kind.

One must also consider whether the existing retaliatory stockpiles are not in fact serving to increase the threat which they are supposed to be deterring. Just as NATO military tend—as is part of their job—to be mistrustful of Soviet intentions, so also are the Soviet military likely to be mistrustful of NATO

intentions. Under such circumstances, President Nixon's declared chemical-weapons policy of no-first-use could well be perceived as concealing a real policy which did not preclude first use. This, it must be remembered, was apparently the situation in U.S. chemical-weapons policy from 1934 to 1942, according to Colonel Brown's study of the official documents of the period. Moreover, in the eyes of the outside world, the United States is not exactly rushing to ratify the Geneva Protocol.

On any rational assessment, whether made by the Soviet Army or by the U.S. Army, the offensive value of nerve gas declines rapidly after its initial employment, once the element of surprise has been lost, and the enemy is in full protective posture; and the Department of Defense has recently announced its intention of "modernizing" its nerve-gas capability. Under these circumstances, should the military advantage of using nerve gas first be ceded to an enemy who, because of this "modernization," may be better able to take that advantage? One can envisage Soviet planners being led by this sort of reasoning to increase Soviet chemical-warfare preparedness, the outcome of which is very likely to be seen, in American eyes, as an increased Soviet threat. General Abrams' recent remarks on the subject of the Soviet antigas equipment captured during the Yom Kippur are the latest manifestation of a now rather traditional custom in this country of portraying improvements in the Soviet antigas protective stance as evidence of an increased Soviet nerve-gas threat. One may thus suspect the presence of self-fulfilling prophesy in the rationales behind current U.S. chemical-weapons policy.

There is a further dimension to this. During the past two or three decades, the U.S. has become very much the leader of technological fashion in the military world. If the United States not only continues to maintain a nerve-gas capability, but also embarks upon an elaborate modernization program for it, is there not a risk that the interest of other countries in nerve gas may not be aroused? Might it not be, then, that current U.S. policy is serving as a stimulus to that process of assimilation and proliferation wherein the real danger of nerve gas for U.S. security may reside?

CHEMICAL DISARMAMENT AS AN ALTERNATIVE TO CHEMICAL DETERRENCE

There are grounds, then, for admitting the possibility that the particular policy option which has been adopted by the United States for mitigating the nerve-gas threat may be inadequate, and may even be counterproductive. Are there not other options available that may be more appropriate?

One such option for meeting the threat is to rely, not on a counterthreat that may well be ineffectual, but on the prospects for removing the threat altogether—the immediate threat, and the proliferation threat—by means of internationally-negotiated chemical disarmament. I get the very distinct impression that this option has not been fully explored by policy-makers in this country, even though international negotiations on chemical disarmament have been going on, with U.S. participation, since 1968. Such advocacy for chemical disarmament as there has been within the Administration has always been dampened by the traditional gut-reaction of the military against arms-control measures, articulated in this case in the contention that chemical disarmament would be impossible to verify adequately.

It is the function and the duty of the military in any country to preserve national security, although security does not, of course, reside in military might alone. Whatever the military have to say about security matters must therefore be assessed carefully and with respect. And it is undoubtedly the case that, just as there is a risk to U.S. security in the continued existence of nerve gas stockpiles, so also would there be a risk if the U.S. got involved in international chemical disarmament that was incompletely verified. What is needed, therefore, is some form of logic which decision-makers can use to assess the balance of risk between the two alternatives.

In this connection, the U.S. delegation at the Geneva disarmament talks has made a very valuable contribution, even though at first sight it appears a rather negative one. The delegation has said that the United States is unable to accept currently-proposed chemical-disarmament measures because the provisions for verification do not ensure as much security as does the existing U.S. posture of like-with-like deterrence. There is a logic implied in this which, if taken further, could well bring about a safe and worthwhile breakthrough in the negotiations. What is being suggested in the U.S. position is that the assessment of risk should be between, on the one hand, the maximum degree of verifica-

tion that is negotiable, and, on the other hand, the security benefits of chemical deterrence. Hitherto, the tendency in this country has been to assess the risks of incompletely-verified disarmament without any reference at all to the degree of security provided by chemical deterrence.

What I am saying here, essentially, is that military opposition to chemical disarmament as a viable alternative to chemical deterrence has been formulated in terms of demands about verification which are unreasonable and excessive. I suggest that it is the function of verification to assure the benefits to security, no more and no less, of replacing a policy of chemical deterrence by participation in international chemical disarmament. This is not a particularly original proposition; but I believe that its implications deserve the fullest possible scrutiny during the decision-making processes that are currently underway in this country regarding chemical weapons.

One such implication is that, since chemical deterrence can, for the reasons described earlier, make no more than a very modest contribution to U.S. security—if, indeed, it can make any contribution at all—it can safely be dispensed with in return for international chemical disarmament measures that incorporate only a modest degree of verification. Further support for this conclusion lies in the fact that appropriately verified chemical disarmament can also serve to constrain nerve-gas proliferation, which is a security-benefit that a posture of chemical deterrence cannot provide. All this is predicated, of course, on the assumption that existing levels of antigas protection will be maintained, and that they will continue to be supported by an active R. & D. program.

A second implication is that, if it is indeed reasonable to identify the proliferation danger as the gravest part of the nerve-gas security threat, then verification procedures should be designed and negotiated primarily in order to control proliferation.

Policy Implications of the Binary Program

When the problems of chemical disarmament, and of its verification requirements, are analyzed in the manner suggested above, they do not appear to be insurmountable. Pressures for a successful conclusion of the Geneva negotiations have been building up steadily over the years. It is an achievement of U.S. foreign policy that this should be so. Because controls over nerve-gas proliferation may result, a great deal stands to be gained from a successful outcome, in terms both of U.S. security and of international security.

But one very substantial obstacle to further progress at Geneva is now materializing. What has happened is that, over the last few months, a chemical-weapons research program that has slowly been gathering momentum since 1954 has reached the point where decisions are being made within the Department of Defense about full-scale development and procurement. The weapons in question embody a new principle for disseminating nerve gas, and are known as "binary munitions." The decisions are apparently being taken without any reference to United States policy for the Geneva talks.

If the Department of Defense decides to go ahead with binaries, it is entirely possible that the spectacle of a new round of nerve-gas procurement by the United States will kill the disarmament negotiations completely, regardless of any new position that the United States may adopt at Geneva. The U.S. delegation there has in fact been waiting since mid-1972 for a substantive updating of its negotiating position; if the National Security Council does not get around very soon to finalizing a new negotiating policy, taking the binary program into consideration, the Department of Defense will have preempted it.

It thus becomes apparent that the future of the binary program (which DoD regards as a routine measure of stockpile modernization) is now the determining factor in U.S. chemical-weapons policy-making. If the program goes ahead, it will lock U.S. security still more deeply, and perhaps irrevocably, into what many people regard as a futile and dangerous policy of chemical deterrence. If the program is curtailed, decision-makers will have more time to weigh up the relative merits of chemical deterrence and chemical disarmament, and thus, hopefully, to develop a policy which will bring the very great dangers of nerve-gas proliferation under control. And binaries, for technological reasons, are likely to promote proliferation.

The initiative for the present is with Congress, but unless Congress acts it will pass back to DoD within a few months time. The fiscal year 1975 budget, on which legislation will shortly be due, contains, for the first time, a line-item on

binary procurement. It is a small item, only $5.8 million, too small to excite much interest normally. But because it is the thin end of a very dangerous wedge, it is to be hoped that Congress will scrutinize it carefully. If it is not excluded from the appropriation legislation, it may well be claimed that the binary program, and all its ramifications in the arms-control arena, have received Congressional approval. There will then be foreclosure on an option which holds out very real promise for improving U.S. security to a far greater extent than binaries ever can.

Mr. ZABLOCKI. Thank you, Dr. Robinson.

Mr. Alan Pittaway, if you will proceed sir.

STATEMENT OF ALAN R. PITTAWAY, ARTHUR YOUNG CO., WASHINGTON, D.C.

Mr. PITTAWAY. Thank you, Mr. Chairman. I, too, have prepared a statement that I would like to introduce into the record and would like to paraphrase some points from it.

Mr. ZABLOCKI. Without objection, your complete statement will be made part of the record at the conclusion of your summary. You may proceed, sir.

Mr. PITTAWAY. I hope that the committee will bear with me. I am not as thoroughly prepared as my eloquent colleagues, but I would like to make some references from material that I have with me today.

Most of the area of activity that I have been involved with in chemical warfare has been two dimensional and a dichotomy. On the one hand, I have been involved in the development aspects of these systems; and on the other hand, I have been involved with the problems of treaty verification and systems of verification for arms control agreements.

RESEARCH ON VERIFICATION METHODS

I would like to discuss primarily those issues of concern that you have in the areas of verification, with some additional comments on the use of chemical weapons as a deterrent for the employment of chemical weapons.

The research work on verification has primarily been the result of activities funded by the U.S. Arms Control and Disarmament Agency. In the process of exploring this field, the concepts that have been examined have been based on an analysis of the set of activities that are necessary to establish a chemical warfare capability, of which there are essentially seven types:

(*a*) The research necessary to identify agent materials and the dissemination methods.

(*b*) The development activity to perfect those munitions, the production processes, and the delivery systems.

(*c*) The testing to develop and perfect the employment techniques.

(*d*) Production, transportation, and storage to achieve a capacity.

(*e*) Countermeasures to offset opposing capability.

(*f*) The deployment to make the capability accessible to troops, and

(*g*) The troop training to make the employment effective.

THREE TECHNIQUES OF VERIFICATION

Considering these seven activities, the research effort to date has concentrated primarily on the production, transportation, and storage functions. There are three basic approaches to verification that have been explored, and the goals of the verification avenues have been either to achieve control over the means of obtaining the chemical warfare capability, to provide confidence that warning of an attack will be given in sufficient time to take defensive action, and the introduction of disincentives which will make an attempt to evade a treaty unprofitable.

The three techniques of verification that can be applied are, in broadly stated terms, technical inspection, economic monitoring, and intelligence activities.

With respect to technical inspection, the technical inspection has been defined primarily as physical means for looking for physical activity, and it relates to the activities that are involved and not necessarily to the means used in executing a technical inspection task, and by this I mean that there are various characteristics of specialization that are involved with those seven different kinds of activities that I referred to earlier. If you are looking for troop training, you may be looking for doctrinal materials; and if you are looking at the production of organophosphorus agents, you may be looking for a distillation tower 200 feet high and 20 feet in diameter.

ECONOMIC MONITORING

Economic monitoring has been the thrust of the most recent research activities as far as verification procedures are concerned. Economic monitoring has many strengths associated with it, particularly in view of some of the problems that are involved in the technical inspection area. In this sense we refer to economic monitoring as a broadly related set of things in which we are looking at the records associated with physical activity rather than the physical entities themselves.

We also recognize the fact that economic monitoring can be either active or passive in nature, and we define this by saying that active economic monitoring is a set of activities in which you cause certain kinds of records to be created in order to produce a mechanism through which you can follow certain kinds of activity, and passive monitoring would be the observation of records that are normally kept in the conduct of business or ordinary affairs.

In theory, economic monitoring can be applied to any of the seven sets of activities, but in the practical case, it is severely limited in some of them. For example, economic monitoring applied to research for new agents would be severely constrained because economic monitoring is also based on the premise that there is sufficient dissimilarity between conventional activity and unconventional activity that you can differentiate between them, or also that the size of the thing that you are looking for is significant and against the background of normal activity.

Inasmuch as research for new agent materials is a very low level activity financially, and in fact most new agent materials have not been discovered as the result of directed research in that field, finding them by economic means would not seem to be very productive. How-

ever, economic methods applied to the production of a wide variety of different types of chemical warfare agents themselves would seem to to be quite useful.

INTELLIGENCE TECHNIQUES

Intelligence techniques differ in kind rather than type. Again we would foresee that intelligence techniques would imply both physical inspection or technical inspection or technical inspection and economic methods, but the route of employing those methods might be different.

To date, there are strong indications that no single set of the three techniques can be utilized by themselves to produce high assurances of verification. Some combination of two or more of the three techniques will probably be required.

I would like to make a few comments about what ideas have been explored with respect to employing these various kinds of techniques and what some of the results have been.

PROBLEMS WITH THE TECHNICAL INSPECTION

A very thorough study has been made of the kinds of things that one might want to look for in the technical inspection area for the production, transportation, and storage of organophosphorus nerve agents and their associated munitions. The chemical problem is different from, say, the inspection in the biological problem area. In the biological warfare area, the problem is to determine the absence of production when you know the agent and you know basically what the production methods are, and also knowing that the technology is going to closely parallel the commercial practices. The organophosphorus nerve agent dilemma is to solve the problem when neither the method nor the agent is known, but knowing that the practice may be different from commercial practice.

There are very large numbers of potential organophosphorus agents that could be used as chemical warfare agents. What one country will produce and how that material will be produced is determined by its chemical economy and by the amount of material that will be required in order to achieve what they consider to be a national capability. There are basically some 16 chemical families which are organophosphorus nerve agents.

GB or the German agent Sarin represents one agent from one family. The agent VX represents one agent from one family. The German agent Tabun represents one agent from one family. So when I say that there are 16 families of these agents, you begin to get some perspective of the magnitude of the kinds of materials that can be employed as CW agents, that all belong to the generic family of organophosphorus nerve agents.

There is no reason to believe at this time that 16 families may constitute the entire set; other families may be found.

FACILITY INSPECTION

Recognizing these limitations it was possible to approach the problem in such a way that it could be defined and produce high assurances that if you had access to a specific site and could go in with a trained inspector you could make a determination whether that facility was

or was not involved in the production of an organophosphorus nerve agent and/or a precursor to an organophosphorus nerve agent. The methodology and the techniques are applicable both to the production of finished agents and the production of binary agent materials.

There are possibilities open in the munitions areas since the munitions themselves are in fact distinctive enough so that if you had access to a particular production facility, if you were looking at a shell production line, for example, there are enough differences in the munitions so that you could in fact distinguish between whether you are looking at a high explosive artillery shell or something that is intended for another purpose, particularly in binary. We are, however, very close at this point to inspecting the conventional weapons systems of another country, and indeed the thrust of the work that has been done in the technical inspection area has not really gone too far in that direction.

TRANSPORTATION

The same is involved in the transportation area. The transportation area offers a method of following from one point to another point a series of suspicious activities. Transportation in and of itself has certain kinds of distinctive features under certain kinds of circumstances, but it is at this point hardly considered to be a definitive single approach. It is one aspect among many that can be involved in an integrated set of verification procedures, if necessary.

At this point nothing has been done in the area of development of similar kinds of data and information on anything other than the organophosphorus nerve agents. If one wanted to be similarly knowledgeable in the area of phosgene production, of mustard agent production and so forth, similar and additional kinds of studies would need to be undertaken.

ECONOMIC APPROACH: TWO DIFFERENT THRUSTS

The economic approaches that have been taken to verification have had essentially two different kinds of thrusts. One thrust has been the use of economic methods in order to try to pinpoint specific kinds of agent materials that a given country is capable of producing and the quantities of those agents that could be produced.

The second approach has been that of looking at economic monitoring as a method of control over the production of agents and the verification of the absence of production, or introduction of disincentives for the production of agents.

Models have been developed of national control schemes based on economic techniques. The primary purpose of a national control scheme is to provide information to other nations, preferably through an international body which has auditing capability, so that you can produce information suitable for examination by others to verify the absence of production of a chemical warfare material.

SINGLE AND DUAL PURPOSE AGENTS

There is a nuance involved here and that is that one must consider the aspect of both single purpose and dual purpose agents. We define the difference in this way. A single purpose agent is something like

an organophosphorus nerve agent whose sole purpose is use as a chemical warfare material. A dual purpose agent is something like chlorine or phosgene which has a use in the chemical economy; in fact these kinds of materials are basic building blocks in the building economy which have to be produced in order to make the society in which we live function. With dual purpose agents we are concerned with building assurances that the quantity of materials produced are in line with civilian requirements and cannot be converted and/or stockpiled for chemical warfare consumption.

The type of control that can be exercised over various kinds of chemical warfare material, dual purpose and single purpose, are dependent upon the materials themselves. If you are talking about an organophosphorus nerve agent then controlling phosphorus offers an avenue. If you are talking about the herbicides, there is nothing in the production of herbicides per se where you can monitor a specific chemical input item. Consequently, you have to monitor the production of the total output to see that it is in line with civilian requirements.

RISK FACTORS IN ARMS CONTROL AGREEMENTS

One problem that has been uncovered in doing this work is that there seems to be no feasible high assurance method of applying economic monitoring to the ethylene or ethyl alcohol raw materials that go into mustard manufacture in countries with large chemical economies. We are talking about items of commerce which are the basic raw material produced in such large quantities and such diverse parts of society that control in a major country like the United States is almost technically infeasible. Here we get into a discussion of the risk factors that are involved when one sets up arms control agreements. The risk factors involved in the production of chlorine phosgene, mustard kinds of materials, vis-a-vis ourselves and a major international power like the Soviet Union, for example. Production of dual purpose materials is not an item of consideration or it should not be an item of consideration in deciding to enter into a CW treaty because of the fact a major power would not employ any of those kinds of materials in a battlefield situation since each has the capacity to produce a much more viable material as a chemical warfare agent.

However, when you are dealing with middle-level countries and small countries, their neighbor's raw chlorine capacity, ethylene capacity, or phosgene capacity, may be of very great concern to them, and these economic approaches are very applicable to total control under those kinds of smaller country environments. Even the mustard production problem is controllable in the small country environment.

THE PROBLEM OF INTERNATIONAL VERIFICATION

The concepts of how a national control agency would work, can work, are fairly thoroughly discussed in the prepared statement and are much more thoroughly discussed in a monograph published by SIPRI which is a shortened version of work that was undertaken in this subject field by the U.S. Arms Control Agency.

The work that has been reported by SIPRI on economic techniques concentrates on the national control agency without getting into the

issues of how an international organization would be set up to verify national agency reporting. This is because that at the particular point in time when the papers that were being prepared for the SIPRI conference, technical experts in the Soviet Union were at liberty only to explore the concept of how agent production would be controlled at the national level. The international control aspect of this is a very tractable problem also. If the treaty verification approaches were to go in this direction, it seems to us that it is perfectly feasible to set up at total system.

There are many holes in what we know currently about various verification technical approaches. Essentially what has been done to date is to explore various avenues to determine whether or not it is feasible to think in terms of these kinds of concepts. Nothing has been done in terms of finalization of these ideas into an implementable system. When we say in our negotiations that, for example, we don't know what verification procedures would be acceptable, one way to interpret that is to say we have not definitized the kinds of assurances that can be gained by using various kinds of techniques and approaches. We have developed at this point no overall strategies to verification and no integration of those approaches into a viable scheme. The studies have just not been undertaken at this point. I think this is one of the most fruitful areas where further work certainly needs to be done.

The work has concentrated primarily, as I have said earlier, in the area of agent production. There are certainly other profitable areas that could be explored over those seven sets of activities that we have referred to earlier.

POSSIBLE MISINTERPRETATION OF INCREASED DEFENSIVE CAPABILITY

At this point I would like to interject a comment concerning the countermeasures area. One of the reasons that we are somewhat at a loss to predict Soviet intent in this particular field is because of the very strong defensive capability built by the Soviet Union. You know, this is really being considered as a indication of an intent to use chemical warfare. One of the aspects of the United States not having a strong chemical defense system is an underscoring of our very sincere position of not employing these materials on a first use basis, and to hold what we have as a reserve and a retaliatory threat. Increase in a defensive capability can be misinterpreted to mean a future intent to use chemical warfare, because you cannot use such a weapons system until you have strong defensive measures to protect your own troops.

U.S.S.R. SEES NEED FOR VERIFICATION

There are benefits of exploring verification issues as far as arms control negotiations are concerned. I think we have seen, over time, a rather major shift in the position in the negotiations as it has become more apparent to those that are not technical experts in the field, that some of these problems are in fact tractable. The Soviets, for example, have moved from saying that everything should be done on the basis of trust to saying, well, now, you know, maybe verification is a viable avenue to be explored.

In the conversations that I have had with the Soviets, they have expressed very strong feelings on the need for verification procedures and certainly have been very receptive to ideas that have been proposed in this field. We have also seen a progression of interest at the international level, the first issues were associated with—well, is it possible to even find out that a particular facility is producing or not producing an organophosphorus nerve agent. When answers started to come back, yes it is possible, then the conversations moved to how do we trigger the need for a physical onsite inspection. The need for a method of triggering onsite inspection is essentially the reason that we moved into exploring the economic monitoring techniques.

TECHNICAL KNOWLEDGE IMPROVES TREATY DISCUSSIONS

Also I think a technical knowledge base improves the communications in discussions of treaties. When one realizes that, for example, in the phosgene area, even in such a large chemical economy as the United States there are only 15 plant production sites it tends to put an undertone of reality in the disarmament discussions that I think helps them as they move forward in the analysis of the verification problems.

NEED TO RETAIN CHEMICAL WARFARE CAPABILITY

I would like to turn now to addressing a few remarks on the need to retain chemical warfare capability until adequate chemical warfare treaties are signed. It is my opinion that the ability to retaliate in kind is a significant deterrent to use by either side. I agree with Dr. Robinson when he says that chemical weapons are not necessarily a viable weapon system and I would add to that such a statement is true if, and only if, both sides have it and both sides have it in equal capacity. In that situation chemical warfare becomes a null power factor and the disadvantages to opening an engagement with it become very large in the military mind.

I would disagree with my colleagues here today from the standpoint of their statements on the viability of the protection devices that are afforded by current known methods of troop protection. Significant analyses have been made as to the capacity of these weapon systems when used against well equipped troops, or when the assumption is made that they are well indoctrinated in gas warfare technology, disciplined, and have good equipment. Under these conditions it can be demonstrated that an artillery attack by an agent such as GB has the capacity to destroy the military effectiveness of almost any kind of troop unit against which it is applied.

PROTECTIVE EQUIPMENT INADEQUATE PROTECTION

As far as the concept of being able to utilize what we now know of protective equipment in terms of offering full time troop protection, I just don't believe that that is possible. It is not possible to wear this kind of equipment on a 24-hour-a-day full-time basis. When we look back in history we find that history has said that even in the midst of the chemical activities that were going on in World War I, maintenance of gas discipline for troops was extraordinarily difficult to do.

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The equipment such as masks and so forth, is much better today but it is not that much better.

I would submit that trying to conduct military operations as we now know them today in fully protective gas equipment is extraordinarily difficult. Such things as sighting artillery pieces, operating vehicles is extraordinarily difficult to do in a gas mask. If you have ever put on a gas mask after eating and have worn it for a period of several hours, the putrefication of the small particles of food that are inside that gas mask with you make you want to get it off.

I would also submit that the devices for taking care of human bodily needs have not been addressed in these equipments either. This was one of the major problems of World War I where 67 percent of the gas casualties essentially came from the fact of troops having to take care of normal body functions; the areas of their persons affected by the persistent types of agents reflect the needs to take care of those problems.

CW RETALIATORY CAPABILITY AN ALTERNATIVE TO NUCLEAR WEAPONS

Consequently, the ability to retaliate in kind I think does offer a very significant deterrent because knowing that if you use a chemical warfare agent and it is going to be used back against you, there is a null advantage to doing so except to increase the rate of attrition. Also, knowing that if you do use chemical warfare you must change your entire concept of how you are going to engage in combat, is a very significant deterrent.

The use of nuclear weapons as a retaliatory capability frankly scares me. I would very much hate to see the initiation of nuclear conflict in a nonnuclear situation merely because that was the only viable response that we had to be a chemical weapon attack. It is my opinion that in the absence of the ability to retaliate with chemical weapons in a nonnuclear engagement, where they were being used against us, there would be no possible recourse except to go immediately to nuclear weapon systems because of the devastation that would be wrought against our troops.

Concerning statements made on the availability of defensive equipment on the continent of Europe at this time, I think what we are doing is really running a calculated risk that our retaliatory capability will prevent the initiation of any kind of a chemical warfare. The risk involved is that we may be pushed off the continent of Europe if a chemical attack is launched against us and that risk is increased without a viable chemical warfare retaliatory capability.

With that I will conclude my remarks.

Thank you.

[Mr. Pittaway's prepared statement follows:]

PREPARED STATEMENT OF MR. ALAN R. PITTAWAY, ARTHUR YOUNG CO.

INTRODUCTION

In the memorandum describing these hearings, three issues of concern were listed:

Status of the Geneva Protocol of 1925 and the U.N. Convention on Biological Warfare

Status of current negotiations at Geneva on a Comprehensive Chemical Weapons Arms Control Convention

Reevaluation of the current U.S. Policy on Chemical Warfare and a determination of the need to retain a retaliatory chemical warfare capability.

Of these three I can make a contribution on the second and third from first-hand knowledge and experience. Further, I will confine my remarks to those parts of concerns two and three which are within the limits of that knowledge.

To assist the Committee in placing my statements in perspective, I would like to state why I have been involved in this field of research.

My involvement during the ten years of my association with technical problems of chemical warfare treaty verification has been based on the following premises:

Given that chemical warfare treaty discussions were to be conducted between ourselves and other nations, our negotiators should be as fully informed as possible on technical details to insure the interests of the U.S. are protected. I have therefore felt a responsibility to lend my efforts to this end.

Second, given that a treaty is viewed as a desirable goal, technical contributions can do much to assist the negotiations in achievement of that goal by providing knowledge which can produce a common basis for agreement.

Third, when dealing with weapons systems which have the capability of some chemical warfare agents and their associated munitions, national security can also be enhanced with arms control systems, provided that the control systems are effective. Producing an effective system involves technical problems worthy of the most careful consideration.

As will be noted from the details of my resume, I have concurrently been involved with the development of these chemical warfare weapon systems, particularly in the areas of utilization and effectiveness determination.

It would be most appropriate to acknowledge the contribution made by the U.S. Arms Control and Disarmament Agency (USACDA) in the field of verification research. The United States has made many primary contributions to technical verification issues, and has virtually led all others in this field. All of these contributions have been the result of research work sponsored by USACDA with their very limited research budgets. The development of this field of research has been limited not by the quantity of problems, or the quality of ideas and research staff, but by available funds to undertake the required studies. In addition, the efforts reported here are the result of work done by several investigators, most notable of whom are Robert E. Roberts, Don Epp, Wesley Weigand, Al Meiners, and all others of Midwest Research Institute in Kansas City, Missouri.

II. THE TECHNICAL PROBLEMS OF CHEMICAL WARFARE ARMS CONTROL VERIFICATION

The issue of concern related to current negotiations at Geneva involves verification problems. The need for verification of treaty commitments is a separate question which will be addressed in Section III of this statement. At this point, accepting the fact that it is involved in the negotiations, it is worthy discussing.

It must be accepted at the outset that there are no simplistic procedures to the technical problems of verifying compliance with a chemical warfare treaty. On the other hand, it is equally true that technical procedures now under consideration can provide assurance of compliance provided the political problems can be solved. It is also true that the technical studies that have been made have done much to resolve a number of political issues.

The following parts of this section will cover:

The activities involved in achieving a national chemical warfare capability which can be the subject of verification.

The approaches to verification.

The status of our knowledge about verification and areas where further study is required.

The benefits which have been observed in the negotiations as a result of exploring technical verification questions.

1. The Chemical Warfare Activities Involved in Achieving a Capability Which Are Potential Technical Verification Subjects

There are seven types of activities associated with achieving a chemical warfare capability. Analysis of the process involved shows that a chemical warfare capability requires:

Research to identify agent materials and dissemination methods.

Development to perfect munitions, production processes and delivery systems.

Testing to develop and perfect employment techniques.
Production, transportation and storage to achieve a capacity.
Countermeasures to offset opposing capability.
Deployment to make the capability accessible.
Troop training to make the employment effective.

Research is the effort which identifies new types of chemical compounds useful for military purposes, and studies their properties to determine appropriate dissemination techniques. Agent search to determine new classes of agent materials is almost entirely independent of a directed chemical warfare program, since all publicly identified agents have been derived from research originally directed toward other purposes. Extensive research efforts are necessary within a chemical warfare program to identify specific useful agents within a given class of agent materials, to develop conceptual production routes for the agents, and to study mechanisms of the most efficient and effective means for agent dissemination.

Development activity is broad in scope and can be considered under two headings—agent development and delivery systems development. Agent development would include field evaluations, determination of optimum production processes (to include pilot plant development), and prototype studies of dissemination techniques. Munitions development includes conceptualization, prototype production, and evaluation of delivery systems. Also involved is the evaluation of effectiveness for field use and initial development of employment doctrine. For these tasks, suitable laboratory, pilot plants, field test facilities and skilled personnel (including operations research skills) are required.

Field testing is essential for perfecting employment technology. It requires characteristic physical facilities situated in remote locations. It cannot be undertaken until the development phase has reached the stage of including development of agent production processes and pilot plant production capability. In a deliberate chemical warfare program, the amount of testing required is extensive and must include trials under all environmental conditions of weather and terrain where use is anticipated. The product of testing is employment doctrine.

Production, transportation and storage are the activities required to accumulate the physical resources for conducting chemical warfare. Production requires construction of chemical plants, construction of munitions fabrication facilities, construction of facilities to join the agent with the hardware, the act of producing the agent and filled munitions, and stockpiling.

Countermeasures are the set of activities undertaken to oppose someone else's capability, and include research, development, testing, production, stockpiling, deployment and training in both detection methods and protective equipment. The level of effort is comparable to the same sets of activities conducted for offensive capability.

Deployment of munitions is the act of transferring material to storage points which are accessible to the troops who will use it.

Training of troops in the offensive and defensive employment of chemical munitions is the concluding activity in the achievement of a capability. Key military commanders and staff at all levels must be educated in the employment doctrine. Failure to instruct all command levels, or to indoctrinate thoroughly those instructed, will result in effective use or the absence of use.

2. The Three Verification Techniques

The objective of verification is to provide assurance that parties to an agreement are abiding by its terms. This assurance can be attained through a variety of mechanisms, whose goal may be one or more of the following:

Control over the means of achieving a capability.

Confidence that warning of a requirement to take defensive action will be given in sufficient time to take such action.

Introduction of disincentives which will make an attempt to evade the treaty obligations unprofitable.

The techniques of verification play a role in achieving these goals. No simple verification technique can achieve all three goals when applied against all seven sets of activities involved in achievement of a national chemical warfare capability.

The three primary verification techniques which can be used to control, give warning or produce disincentives are technical inspection, economic monitoring, and intelligence activity. Each of these techniques, when applied to the seven

types of activities involved in achieving a chemical warfare capability, has both advantages and disadvantages with respect to its ability to provide meaningful impact on the three verification objectives.

(1) *Technical Inspection*

Technical inspection can be directed toward any of the seven activities involved in achieving a chemical warfare capability. Technical inspection is a direct approach to verification and must be defined broadly as including all actions which seek to examine the substantive aspects of an activity involving achievement of chemical warfare capability. In this sense, it is not a form of inspection which relies on instruments and other hardware. The term "technical" does not refer to the methods used; it refers instead to the activity being examined. To illustrate this very important point, consider that in each of the seven activities there are characteristics of specialization which set them apart from other types of activity. These "characteristics of specialization" are the technical attributes associated with chemical warfare. Technical inspection is the act of looking for these specific technical attributes. The means used for searching them out will vary with the type of technical activity involved, but in general they will be physical means and will be used to look for physical activity. Two examples will illustrate the breadth of scope involved. Technical aspects or "characteristics of specialization" involved in troop training include:

gas training chambers
gas masks
prescribed courses of instruction in training doctrine
manuals
special technical schools
munition expenditure tables
example mock-ups of delivery systems
specialists in military tables-of-organization
training exercises for familiarization.

Technical inspection applied to this physical activity would use a variety of techniques to determine if these characteristics were present in the military structure.

As a second example, consider the technical aspects of an organophosphorus nerve agent production facility. These include:

Presence of organophosphorus compounds with a carbon to phosphorus chemical bond.
Total environment protection of equipment or total protection of workers (assuming non-binary munitions).
Specific types of leak detectors.
Extensive on-site medical facilities.
Low use of water as a heat-transfer medium.
Large use of refrigerant coolants.
Characteristic patterns of equipment linkages.
Specific items of equipment.
Characteristic chemical by-product production.
Characteristic patterns of raw material inputs.

Obviously in this second example the technical inspection effort would be materially different, *because the characteristics of specialization are different* between the two types of activities in the examples. In the first example the search for the physical attributes requires the skills of a good detective and the primary physical means are the inspector and his eyesight. In the second example, a skilled chemical engineer specially trained in what to observe is required who will undoubtedly require specialized items of equipment to execute his examination of the physical aspects of production.

Since each of the seven activities associated with achieving a CW capability has specialization characteristics, all are susceptible to some form of technical inspection. Obviously, technical inspection produces information useful for all three verification objectives, that is, control, warning and disincentives. The relative degree of verification which can be achieved in each of the seven activities and the level of effort required are, of course, subjects beyond the scope of this discussion. The principal problem with technical inspection is the level of intrusion required to identify the presence of some of the specialization characteristics in the seven activities. This factor leads to either a compromise with the type and number of specialization characteristics used, or creation of a mechanism which can "trigger" authorization for on the spot, detailed physical technical inspection.

(2) *Economic monitoring*

Economic monitoring has more limited potential application than technical inspection but has compensating advantages. Compared with the direct nature of technical inspection, economic monitoring is an indirect verification technique: whereas technical inspection involves a search for the physical means of achieving a capability, economic monitoring is concerned with the records created in the process of achieving a capability.

Economic data in the context of this paper is defined as information on the production, distribution and consumption of physical resources required to produce chemical warfare agents. Monitoring is the review and analysis of such data with a view to determining that the resources required are not being used in agent production. An economic-data reporting and monitoring system is a defined method and procedure for the routine collecting, processing, accuracy verification, analysis and reporting of information, in a manner useful for determining compliance with treaty specifications.

Economic monitoring can be either active or passive. Active economic techniques would be used when emphasis is placed on control and/or disincentives as verification approaches, and would ordinarily require the creation of records which could be used to verify inputs and outputs associated with specified activities. Passive economic techniques are less restrictive and also less definitive. They would normally require monitoring of the information contained in records created in the normal course of operations. Thus active methods seek to prevent CW activity and/or warn of their occurence, whereas passive methods potentially provide warning only. To the extent that warning of violations is a disincentive to conducting an activity, both methods provide disincentives.

In theory, economic monitoring can be applied to any of the seven activities associated with development of a CW capability, but its practical application is probably more limited. There can be circumstances such that the relationship between the size of the activity being monitored and the size of similar activities in an economy, together with the indistinctiveness of one activity from another (that is, the degree of activity similarity), severely reduces the ability of economic monitoring to identify banned activities. For example, the size of the chemical research activity in an industrialized nation, combined with the close similarity between research directed toward normal activity and agent research activity, would make economic monitoring a questionable technique for this type of activity.

Similarly, the records generated during field testing are unique, as well as being small in number, and therefore can be easily kept from public view, so that economic monitoring would not be effective for this type of activity.

Economic monitoring would seem to be most effective in the areas of production, transportation and storage, since the characteristics of these activities require accurate records, and the size of the operations would make such monitoring feasible. In addition, when the production activity requires a key material which can be made the subject of specific controls, economic monitoring can become a very useful technique for determining that the controlled material is being used for authorized purposes.

One of the principal values of the economic technique is its ability to reduce substantially the demand for technical inspection, particularly on-site inspection.

(3) *Intelligence techniques*

Intelligence techniques encompass a broad range of methods which include both technical and economic approaches. The various intelligence techniques differ primarily in the way the methods are employed, for example, clandestinely, rather than in the type of methods or techniques which might be used.

(4) *Combined verification techniques*

Singly, probably none of the three techniques described above can provide absolute assurance that the terms of a CW treaty agreement are being adhered to. To obtain even "high assurance" will require some combination of two or more. There is obviously a multiplicity of strategies to be explored in evaluating how the three techniques can best be applied to the seven types of activities associated with achievement of a CW capability. To date, only a few of these strategies have been explored.

3. The Status of Knowledge About Technical CW Verification Procedures

Research efforts in the U.S. have concentrated on these aspects of CW technical verification procedures development:

> Technical inspection for production, transportation, and storage of organophosphorous nerve agents and munitions given the location of a site to be inspected.

Technical inspection for field testing.

Economic monitoring systems for agent production and transportation activity.

Obviously there are many problems that have not yet been studied or considered in depth, nor have there yet been concerted efforts to develop overall strategies incorporating two or more verification techniques. However, the work done to date has been thorough and exhaustive, as well as very productive when measured in terms of contribution to understanding of verification issues. A brief overview of some of the findings of this work will be presented in the following parts of this section.

(1) *Technical Inspection for Production, Transportation and Storage of Organo-Phosphorus Nerve Agents and Munitions*

Devising an approach to the inspection problem for chemical agents is materially different from the related problem of inspecting for biological agent production. The biological warfare agent problem is to determine the absence of production when both the agent and the production methods are known, with the added knowledge that the production practice will be closely parallel to commercial practice. The organo-phosphorus nerve agent dilemma is to solve the problem when neither the method nor the agent is known, recognizing that the practice involved may differ materially from commercial operations.

One significant point to be made is that there is not a small finite number of organo-phosphorus nerve agents. There are a finite number of known families or classes of agents. The Germans discovered two classes prior to WWII, and the three agents they developed were from these classes. Since that time there have been 16 classes reported in the literature from which organo-phosphorus poisons can be made. Perhaps several hundred different potential agents could be made from these sixteen classes. Consequently, it is probably not productive to attempt to list as prohibited materials all organo-phosphorus chemical compounds which might be agents. It is more constructive to define their classes. For each class of compounds there are at least 24 theoretically possible production routes unless the element sulfur is involved, in which case there are 48 routes. Each production route can be approached in a number of different ways to produce perhaps a dozen specific production schemes. However, all production routes and schemes involve not more than five types of basic chemical reactions: oxidation, alkylation, esterification, ammination, and fluorination. Therefore, it has been possible to postulate an inspection approach which can identify organo-phosphorus agent production independent of knowing either the agent or the production method in advance.

Using a systematic approach which defines the characteristics of agents and their production processes, it has been possible to define a procedure for establishing a "fingerprint" for the production of different classes of compounds. This fingerprint is defined in terms of:

The chemicals used
The types of reactions conducted
The order of the reactions
The type of equipment used
The intermediate reaction products
The by-products of the reactions
Characteristics of the processing and the facilities

From this approach it has been possible to define the theoretical approaches to production for possible agents (known or unknown), the possible production methods, and the practical methods. It has been generally agreed that a trained chemical inspector could determine the presence of nerve agent production, or production of key intermediate components, to include binary munition components) given access to a specific site.

Munitions component production can be distinguished from conventional munitions activities. The artillery shells for chemical nerve agent filling are produced utilizing different operations than conventional high explosive shells. The type of munitions are different in some instances (because of the agent dispersion requirements) and involve bomblets, spray tanks, multiple rocket launchers, etc. With binary munitions the components would be materially different from their conventional counterparts.

The actual production of finished, filled munitions is a highly distinctive process, readily distinguished from conventional munitions operations. The filling and assembly operation is a critical point in achievement of a CW capability and is the funnel through which all agents and munitions components

must pass. It is the focal point for the major transportation operation, the largest materials handling operation and the center for one of the greatest toxic hazards in the entire manufacturing procedure.

Transportation of agent raw materials and intermediates, munitions components, and finished munitions, is a sizable operation for even modest levels of production. Production of 10 tons per day of GB would require movement of 100 to 200 freight car loads of material per month, depending on the operations dispersal strategy used. Several approaches to transportation monitoring are possible depending on the degree of access afforded and the overall technical inspection scheme.

Knowledge has been developed on organo-phosphorus munitions production, to the extent that viable schemes for technical inspections have been identified. The full details of these schemes have not been developed pending an identified need to carry them further. Data have not been developed on production, transportation or storage of other agents and therefore technical inspection schemes have not been devised.

(2) *Economic Monitoring Systems*

Reasonably extensive studies have been made of various economic approaches to verification. The bulk of this work has concentrated on concepts of verifying compliance with a ban on production of organo-phosphorus agents, but studies have also been made of the feasibility of applying the technique to any type of chemical material for which control is required.

In the course of doing these studies, one of the products produced was a model for a national monitoring and control system to supply economic data to other parties for verification purposes. The model was created to determine the magnitude of the effort required and to evaluate feasibility of the approach. It was also used as a discussion base to determine its acceptability to other country's.

The model encompassed the following elements:

An approach for creating a system to monitor production of single and dual-purpose agents.

The functions and skills required by a national organization to operate the system.

An assessment of the magnitude of the operation at the national level, using the U.S. as a model,

An assessment of the degree of verification which might be achieved using this approach.

Economic data in this context is defined as information on the production, distribution and consumption of physical resources required to produce chemical warfare agents. A reporting and monitoring system is that set of activities associated with the collection and analysis of such data, together with a means of verifying its accuracy. Therefore, the purpose of a national system is to provide a mechanism for collection, analysis an accuracy verification in a manner which enables this information to be shared with, and understood by, other signatories to an agreement controlling CW agent production.

It is obvious that to have significant value, the national data reported must be subject to audit and accuracy verification by a third party. The model for a national reporting system is the vehicle for creation of an "audit trail", which will require some modest level of on-site inspection by a third party to verify.

The use of the term "control" in contrast to the term "elimination" when referring to agent production is deliberate, because of the dual-purpose nature of many of these agent materials. There are literally hundreds of chemicals which have a potential for use in chemical warfare activity, and many of these are basic items of commerce in an industrial society. For example, two of the most widely used agents in WWI—chlorine and phosgene—are basic materials in any chemical economy and absolutely essential to the economic health of an industrial society. Consequently, the objective in many instances is not to eliminate but to control the production of such materials, so as to assure other nations that the quantities involved are not intended for CW purposes.

The type of control to be exercised is determined by the kind of material, the control exercised over other materials and the degree of risk involved in possible violations. Whether the chemical material has a civilian market or is currently specific for CW use influences how economic data controls might be applied. In addition, the chemical nature of the material or the characteristics of its manufacture may dictate the best approach to applying controls. Consequently, the kind of material will determine whether control can be most effectively exercised:

By direct monitoring of the quantity produced and determination of its consumption into other products, for materials such as chlorine, phosgene and hydrogen cyanide;

By direct monitoring and control of specific chemical elements or compounds required for their manufacture, for materials such as organo-phosphorous nerve agents, insecticides, the arsenicals and mustard; or

By direct monitoring of the quantity produced and determination that the quantities are reasonable for the intended consumption, when the chemical involved is both an agent and a final product, for materials such as some insecticides, herbicides and riot-control agents.

When the potential agent material is a complex organic compound, the approach is also determined by whether only one of the constituent chemical percursors is to be monitored, or more than one. For example, various organo-phosphorous agents require phosphorous, a variety of alcohols, amines, fluorine, chlorine, hydrogen cyanide and sulphur. Phosphorous is the key material here, but simultaneous monitoring of more than one precursor will improve the reliability of control.

The degree of risk involved in a potential treaty violation also influences the methodology for applying economic control. A major industrialized state with the resources and technical capability to produce highly toxic organo-phosphorous agents, if required, is not apt to feel that its security would be threatened through the use of chlorine, phosgene, or hydrogen cyanide as a CW agent. Such a nation should be much less concerned with rigid controls on these materials for two reasons. First, their normal production of the same materials for domestic use provides them with an in-kind retaliatory capability, should it be required. Second, and much more important, if a nation were to plan on violation of a treaty, it would procure the best agents available, and not rely on comparatively low toxicity agents such as chlorine and so on.

A similar argument from the risk perspective might be made with regard to mustard-type agents. In static warfare or for barrier and denial operations the mustards are good agents, but the probability of modern static warfare is remote and some of the organo-phosphorus agents are at least as good as, if not far superior to, mustard for either use. Moreover, barrier and denial operations tend to be defensive rather than aggressive activities. These factors tend to mitigate the threat posed by mustard to highly industrialized nations. In addition, the raw materials required (ethylene or ethyl alcohol) are so readily available that the means to produce, on a retaliatory basis, are always available.

On the other and, a less industrialized nation might view his neighbors' chlorine, phosgene or ethylene capacity as a real security threat and may wish to have a rigid accounting of production and consumption.

This dichotomy in terms of risk may require special consideration in the formulation of treaties. While highly industrialized states should be less concerned with these materials from a risk point of view, the task of placing an economic control on materials such as chlorine, ethylene or ethyl alcohol would be considerable, although phosgene and hydrogen cyanide could probably be handled fairly easily.

The model chemical control system (CCS) is an economic reporting and material control network designed to be part of an inspection system for an arms-control agreement controlling the production of chemical warfare agents.

The primary objective of the CCS is to monitor all economic and industrial activities connected with dual-purpose agents and with essential ingredients required in the production of single-purpose agents.

The CCS is designed to monitor the production, storage, transportation, use and consumption of all compounds which are designated as controlled materials. To accomplish this task, the industrial enterprises which produce, transport or use controlled materials are required to maintain internal records and prepare periodic reports on all relevant activities. To ensure the accuracy of these industrial level reports, a number of checks and balances have been incorporated into the system, such as registration of all industrial establishments, authorization of production and use quantities, reports from two or more independent sources on all material movement, and independent audits of the records and material control procedures at production plants. The reports submitted by an individual plant are subject to verification against reports from customers, suppliers and transportation companies with which it does business.

The administration and operation of the CCS is divided between two organizational levels—National Control Agencies and industry. The National Control

Agency is responsible for the operation and control of the system within its country's borders and must provide verification to other National Agencies that industrial establishments have complied with all provisions of the CCS. The industrial level is required to follow authorized material handling procedures, maintain minimum accounting records, and report to the National Control Agency. A general list of functions performed by each level is shown in table 1.

Table 1. Functions of the two organizational levels within the CCS

Levels	*Functions*
National Control Agency	1. Exercise primary legal, administrative, and technical controls. 2. License all production, use, and transportation of controlled materials. 3. License, control, and inspect international trade in control materials. 4. Establish national records for each controlled material and plant. 5. Verify accuracy of industrial level reports. 6. Audit/inspect industrial records and operations. 7. Report activity in controlled materials, nationally and internationally.
Industry	1. Furnish data to National Control Agency pertinent to controlled material. 2. Follow material control procedures as directed by national government. 3. Maintain records as directed by national government. 4. Respond to challenge audits/inspections by National Control Agency.

Using the U.S. chemical economy as a vehicle to evaluate the complexity of the system discloses that the chemical control system approach can be implemented with reasonable effort. Since the U.S. chemical economy is the largest and most complex, it is believed that the effort required in other countries would be materially less. Analysis has shown:

Control of phosphorus to monitor production of organo-phosphorus nerve agents would involve 250 plants.

Control of hydrogen cyanide to monitor diversion into agent use would involve on the order of 20 plants.

Control of phosgene would involve about 30 plants.

Control of raw materials involved in mustard manufacture would seem to be impractical at industrial levels comparable to the U.S. economy.

Control of herbicides would have to be based on monitoring of production levels for civilian consumption to insure quantities were in line with requirements. Feasibility is reasonably good that diversions of the magnitude required for military use would be detectable.

The material developed in this technique has illustrated the concept of how economic-data reporting and monitoring could be used in a verification system to control production of single- and dual-purpose agents. Examples have shown how this concept can be adapted to different chemical materials with the purpose of emphasizing its flexibility. However, a careful study will show three inherent weaknesses. First, economic monitoring alone, without authority to conduct in-plant technical inspections for purposes of verifying data accuracy, would permit subversion of the system at will through record falsification. Second, there is nothing in the system as presented which would prevent construction of a dedicated facility outside the monitoring system for purposes of clandestine production. Third, it is not adaptable to controlling mustard production in large chemical economies.

Conversely, its strengths lie in the same area as its weaknesses. Economic-data reporting and monitoring can materially reduce the volume of in-plant technical inspection required to achieve high assurance that known facilities are not being used for clandestine purposes, as well as changing the nature of the technical inspections required. A second strength is that since economic monitoring forces diversion to occur outside the monitored system, other approaches to verification can be focused for specific types of clandestine activity, that is, undeclared elemental phosphorus production facilities.

In some countries it may be necessary to determine that industry is not producing agents or agent materials for use or sale outside its borders. This system, combined with other regulations requiring registration of all chemical plants and their processes, would seem to be a total solution to that problem. However, it is obvious that only governments produce or buy agents for chemical warfare purposes. There is nothing in the system as described herein which would prevent a national government from either subverting the reporting system or building dedicated facilities. Irrespective of how the governing board of the National Control Agency is constituted, as long as the government in power has the authority to appoint its members, its reports would be worthless for purposes of treaty vertification without an independent audit to verify accuracy by an organization at the international level.

There is a need for an international organization to fulfill several functions which would make an economic-data reporting and monitoring system a useful part of an overall verification scheme. First, the reports of the national organizations should be processed by a staff knowledgeable in the subject who could verify the accuracy of the information recorded. It would analyze national accounts and in the event of an apparent discrepancy would conduct challenge audits of industry-level records. It would conduct periodic audits of each National Control Agency and must be permitted complete access to all reports submitted by industry and to the records maintained by the National Agency. In addition, the international organization must have the authority to conduct challenge audits of individual production plants with complete access to all plant records and accounts. The determination of how many and for what reasons these plant audits can be conducted will have a significant influence on the reliability of the system. Apparent discrepancies or other triggers for a challenge audit would be an imbalance in either a national or industry account, large material losses or low production efficiencies, or significant deviations in the yearly use or production of controlled materials. Challenge audits purely for purposes of checking reliability must be permitted.

Second, processing of data by an international organization capable of maintaining a staff of competent experts would assure all nations, large and small, that reports issued on the status of compliance were accurate.

Third, such an international body would maintain the list of controlled items and would have the expertise to determine the need for additions and revisions.

Fourth, reporting procedures, standards of accuracy, detail of reports, and presentation formats must all be standardized. In addition, for each agent or class of agents to be controlled there must be established a defined list of chemical materials on which reports will be provided. Further, the procedures and standards for conduct of audits must be established for each controlled material and this specifically includes the methods to be used in the technical inspections. All such standards and procedures must be published for use at all levels in the system.

Fifth, because in-plant technical inspections will be required to execute audits, there is a requirement to provide permanent employment to a staff who can be dedicated to this purpose. To overcome problems of violating trade secrets and proprietary rights, the inspection staff will be required to give up certain rights to seek employment in the chemical industry. In return, a permanent organization which would provide for their long-term employment must be provided.

While the work on economic techniques has not been an exhaustive study of the subject, it is believed that the concepts have been developed in sufficient detail to assess their potential. It should be kept in mind that when more than one chemical constituent of an agent is monitored simultaneously, the assurance increases significantly, with further problems in attempts at diversion. Further, if production of chemical plant equipment items were also included in the economic monitoring system, the ability of a country to build plants outside the monitoring system would be significantly inhibited. Such an extension seems perfectly feasible and could be added if desired. The administrative burden and system operating costs would of course increase.

3. Comments on the States of Knowledge of Verification Issues

While a significant body of knowledge is developing on approaches to verification, much more work remains before the potential of all approaches are fully examined, or any single approach (or combination of approaches) is developed to the level of an implementable system. Further, there are a host of unanswered

questions surrounding the concept of how a treaty would be implemented and its terms (if any) for closure of facilities and destruction of stockpiles verified.

In the verification of a ban on all use of CW, the subjects of development, countermeasures, and troop training offer avenues to be explored and the role of activity in these areas defined in an overall verification scheme.

Integration of the best set of the three techniques applied to the best set of the seven activities to determine an optimum strategy, has not been undertaken. Currently there is probably too little knowledge available to undertake such a task.

4. Some Observed Benefits of Exploring Verification Issues

The principle benefit of exploring verification issues is to provide a knowledge base to support negotiations. It has a strong tendency to move the discussions from a high level of abstraction down to discussion of concrete issues.

The knowledge base provided to the discussions tends to place the negotiations problems in better perspective. For example, knowing that there are only 15 plants in the U.S. which produce phosgene, only two of which produce for off-site consumption, and that there are methods of monitoring such production if there is a demand to do so, makes the problem seem much more handleable.

It has been observed that discussion of technical issues has tended to shift the position of negotiators when they become more fully aware of the practicability of supplying answers to verification questions and become aware of what would be involved in the verification schemes. For example, a few years ago an issue was the practicability of determining the presence or absence of production of CW agents in a facility, particularly organo-phosphorous agents. At the negotiation level it was considered next to impossible, it was also believed that any pesticide plant could be converted to production virtually overnight. Research has shown that it is practical to inspect plants and the issue has moved to procedures triggering inspection and minimization of intrusion. The point is, that once it was shown that verification problems could be addressed, the negotiations moved from rhetoric on trust and good faith to substantive procedural questions on finding a common ground for agreement.

Recent events have indicated that if acceptable verification grounds can be devloped, perhaps agreements can be achieved.

III. THE NEED TO RETAIN A RETALIATORY CW CAPABILITY

The military capability of organo-phosphorus nerve agents must not be forgotten during discussions about CW treaties. The capability for destruction and/or incapacitation with this type munition is second only to nuclear weapons, and is beyond other potentially third-ranking systems. This fact is sufficient reason to exercise caution in the decision to relinquish a capability until sufficient assurances are obtained that others have done likewise.

Several points can usefully be made on the value of a retaliatory capability:

Ability to retaliate in kind is a significant deterrent to use by either side in a conflict.

Use of nuclear weapons as a retaliatory capability could escalate a non-nuclear conflict into a nuclear one.

Military doctrine of other major powers teaches the combined simultaneous use of CW and nuclear weapons, thus making nuclear weapons ineffective as a retaliatory threat.

Each of these points will be briefly discussed, but it should be kept in mind that a retaliatory capability is not necessary if a nation is assured that CW will not be used against it.

1. Retaliation in Kind

In one respect, the capability of CW is also its weakness. Studies of nerve agent GB have shown that high CW casualty rates can be achieved against well trained troops well equipped with defensive equipment. Prevention of these casualty rates would require continuous wearing of gas masks, which not only interfere with all normal activity, but is a physical impossibility.

Casualty prevention from persistent types of nerve agents with percutaneous capability requires continuous wearing of full protective suits. This is also a physical impossibility which would quickly prevent the execution of most conventional military activity. Contamination of equipment and supplies would soon mean that nothing in the combat area could be touched without risk of casualty. Moreover, these agents are absorbed by paint, plastics, and metals making de-

contamination extraordinarily difficult. In WWI many CW casualties were the result of troops opening and/or lowering their protective clothing to take care of normal body functions, a problem which has not been solved in current protective clothing.

In summary, defensive measures are out-of-balance with CW offensive capability. Use of CW would or could materially change the nature of battlefield conflict and require the employment of greatly different strategy and tactics. In the extreme it could even stop what now might be considered normal battlefield operations.

However, the ability of both sides to employ CW produces a null situation giving neither side an advantage, with concurrent penalties for both sides if the system is ever called into use. As a British military analyst writing on the use of chemical in WWI once said, use of chemicals just made a bad situation worse with no advantage to either side. Therefore, wide and open publicity on the defensive operational impact of CW can act as a preventive to CW use so long as retaliation in kind is possible.

This is not to say that every nation should have a CW capability. For example, a common stockpile available to any nation who suffered a CW attack would be as useful as individual stockpiles. Such a common stockpile might even be an effective alternative to treaty verification procedures.

2. Use of Nuclear Weapons in Retaliation

It has been suggested that nations with nuclear capability can use the threat of nuclear retaliation in lieu of treaty verification. This argument has potential flaws. For one, it encourages nuclear proliferation in lieu of CW proliferation. Second, it has the potential of escalating a non-nuclear conflict into a nuclear one.

It is entirely possible that major and minor conflict can occur without the use of nuclear weapons. If nuclear weapons are the only deterrent to CW, does this not run the risk of starting an escalation whose end might be world disaster? While it may be argued that it is just this threat which will prevent a combatant from initiating CW, it can also be argued that the initiating combatant will also depend on the reluctance of the retaliating combatant to run the escalation risk, and therefore eliminate the credibility of the nuclear retaliation threat. History is replete with examples of miscalculation by national leaders of other nations' expected behavior. An effective retaliatory threat is one which matches the original threat in both power and degree. Use of excessive retaliatory force can make the recipient of that force the object of sympathetic public opinion.

3. Retaliation in the Presence of Combined Nuclear and Chemical Threat

It is known that military doctrine of some nations is based on combined use of nuclear and chemical attack. Such a combination would significantly enhance the casualty potential of CW. While it is reasonable to question the credibility of nuclear retaliation as a deterrent to CW under such circumstances, the larger issue is the maintenance of a power balance in this situation. Until treaties are signed and nations are assured of the elimination of the CW threat, power balance requires a U.S. CW capability. In this interim period the presence of such a capability may be the best preventative to its use.

BIOGRAPHY OF ALAN R. PITTAWAY

Residence:

415 Ben Oaks Drive East, Severna Park, Maryland.

Education

B.S. in Industrial Chemistry, Kansas State University, Manhattan, Kansas, 1950.

Graduate Studies in Chemistry, Kansas State University.

Candidate for M.B.A. degree, University of Missouri at Kansas City, Missouri.

U.S. Army Artillery and Guided Missile School, Career Course.

U.S. Army Command and General Staff College, 5108 USAR School.

Employment

March 1973 to Present—Arthur Young and Company. Principal and Co-Director of Manpower, Education and Social Service Consulting.

1970–1973—Booz and Allen Public Administration Services, Inc., Associate.

1967–1970—Booz and Allen Applied Research, Inc., Principal Scientist and later Research Director.

1950–1967—Midwest Research Institute, Principal Chemist.

Abbreviated chemical warfare experience summary

1963–1965—Studies of explosive munition dissemination of agent VX, under contract with Edgewood Arsenal Studies involved behavior and generation of VX aerosols and included working with live agent. Project Director.

1964–1966—Studied production, transportation and storage of chemical and biological agents and weapons under ACDA Contract ST–56. Study produced a nine-volume encyclopedic presentation of all known knowledge with an initial analysis of how this information could be used to verify compliance with a CW disarmament treaty. Project Director.

1967–1969—Under USACDCCBRA Contract No. DA–04–AMC–845(X) developed and published a revised set of chemical munition expenditure requirements, casualty assessments, and hazard distances for field use. Study developed employment data in probabilistic form for use by all U.S. miltary forces. Data were completed for employment of *all* U.S. agents, for *all* munitions of all sizes, for all delivery systems. Tables were prepared separately for U.S. Army, Navy, Air Force and Marines weapons and delivery systems. Data were generated in computer simulations analysts using methodology approved by MUCOM–ORG, and for each target type, wind condition, temperature, breathing rate, masking time, the 95% confidence of 90% probability that casualties would equal or exceed the published figure was determined. All reasonable levels of fire were studied for all type targets with 128 separate alternative attack situations for each of these two conditions. More than 1.5 million separate attack conditions were computed, consuming 7,000 hours of computer time.

1967—Performed an analysis of the CW protective requirements of attack and utility helicopters to establish U.S. Army procurement requirements. Study involved review and analysis of data on effects of all agents on aircraft and aircraft materials of construction, as well as effects of decontamination agents. Requirements for warning devices were assessed, as well as effects on occupants of flying through agent clouds or picking up contaminated troops. Contract with USACDA as above. Project Director.

1968–1969—Performed a study to determine the effectiveness of conceptual series direct fire enscapsulated flame weapons in comparison to each other and mechanized systems. Study was executed by developing and exercising a two-sided, event-sequenced, Monte Carlo, small unit engagement computer simulation model. Project Director.

1968–1969—Performed an evaluation of the potential effectiveness of a series of artillery and mortar delivered incendiary and flame agents. Study involved analytical modeling of all known parameters associated with casualty generation in materials and personnel with flame and incendiary systems. Project Director.

1970—Performed an analysis of protective systems and munitions performance to establish the effectiveness of surprise GB attacks using bombs, rockets or artillery. Study analyzed the effectiveness of munitions against typical troop units up to 200 kilometers in depth of a zone slice of an army front. A high level of protection capability was assumed. Contract with USACDC as above. Project Director.

1968–1972—Attended four international conferences and symposiums, meeting with the technical experts from other countries (including the USSR) to discuss ways and means of verifying a CW disarmament treaty. Meetings were held at SIPRI in Stockholm. Role was that of senior U.S. delegate. Published three papers in this field through SIPRI.

1966–1971—Served as a mobilization designee to the Department of Army Staff, Office Chief of Research and Development as a Chemical-Biological Staff Officer. Served periodic active duty at the Pentagon.

1969–1970—Developed mathematical formulations of the munitions expenditure effects problems. These open-ended solutions enable calculation of munitions effects using as input any desired value of the variables involved. These procedures were included in the JMEM (Joint Munitions Expenditure Manuals) for use by all services. Contract was with the Joint Chiefs through MUCOM–ORG, Edgewood Arsenal and Mort Shavits, Project Director.

Awards

American Rocket Society (AIAA) National Headquarters Citation for 1960 for advancements made in the field of astronautics, rockets, and jet propulsion.

Patents

3,149,532 patented September 22, 1964. Pittaway and Matthews, entitled "Smoke and Flash Reducer."

Associations and memberships

American Chemical Society, Combustion Institute, Research Society of America (RESA), Reserve Officers' Association, and USAR (Lt. Col., retired).

Publications and papers

Young, H. H. and A. R. Pittaway, "Reduction of Smoke and Flash in Caliber .50 Ammunition." Final Report, Contract No. DA-23-072-ORD-27, Frankford Arsenal, November 1950 to September 1952.

Pittaway, A. R.; H. H. Young; and S. F. Matthews, "Reduction of Smoke and Flash in Small Arms Ammunition," Final Report, Contract No. DA-23-072-ORD-465, Frankford Arsenal, October 1952 to October 1953.

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Pittaway, A. R. and S. F. Matthews, "Reduction of Smoke and Flash in Small Arms Ammunition," Final Report, Contract No. DA-23-072-ORD-709, Frankford Arsenal, 89 pp., November 1954 to August 1958.

Co-author of book, *Reduction of Smoke and Flash in Small Arms Ammunition*, published by Midwest Research Institute for Office Chief or Ordnance, Contract No. DA-23-072-ORD-769, AD 049775 (1954).

Pittaway, A. R., "Experimental Investigation of Rocket Fuels," Reports, Subcontract from Westinghouse Electric Corporation, Aviation Gas Turbine Division, December 1956 to December 1958.

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Pittaway, A. R., "Mechanisms of Extinguishment," Final Report, Ansul Chemical Company, 102 pp., May 1959 to July 1962.

Pittaway, A. R., "Vapor Phase Oxidation of Hydrocarbons," Midwest Research Institute Study Report, April 1963.

Pittaway, A. R .and W. R. Hollingshead, "Pyrocore Burners and Related Surface Combustion Concepts," Final Report, Project No. 2730-C, Industrial Sponsor, 121 pp., November 1963.

Pittaway, A. R., "Radiant Energy Sources," a study of surface combustion, Research and Technology Division, Wright-Patterson Air Force Base, Ohio, March 1964.

Pittaway, A. R., "Investigation of the Flashing of Aerosols," Final Report, USACRDL, published by U.S. Department of Commerce, Official of Technical Services, April 1964, AD 437257N.

Pittaway, A. R., "Flashing of Aerosols," presented at the Fifth Coordination Seminar on Chemical Biological Dissemination Research, sponsored by USA Chemical Research and Development Laboratories, June 3-4, 1964. AD 358326.

Pittaway, A. R., et al, "Production, Transportation and Storage of Chemical and Biological Agents and Weapons," Final Report, Contract No. ACDA/ST-56, 9 volumes, April 1966. AD 375215L; 375216L; 375230L through 375238L.

Pittaway, A. R., et al., "A Comparison of Encapsulated Flame Weapons With Mechanized Flame Throwers Against a Bunker Target," Final Report, USACDCCBRA, Contract No. DA-04-AMC-845(x), June 1969.

Pittaway, A. R., et al, "Development of Chemical Munition Expenditure Requirements, Casualty Assessments, and Hazard Distances for Field Use," Final Report, USACDCCBRA, Contract No. DA-04-AMC-845(x), 6 volumes, June 1969.

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Pittaway, A. R., et al, "Analysis of Protective Systems and Munition Performance to Establish Improved Casualty Estimates from Chemical Fires for Surprise Effects," Final Report, USACDCCBRA, Contract No. DA-04-AMC-845(x), March 1970.

Pittaway, A. R., "Inspection for Production, Transportation and Storage of Organophosphorus CW Agents," Stockholm International Peace Research Institute (SIPRI), Chemical Warfare Inspection Procedures Symposium, Stockholm, Sweden, August 1968.

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Pittaway, A. R.; R. E. Roberts, D. Epp, "An Examination of the Types of Data To Be Reported Internationally From Economic, Statistical and Other Methods by a National Verification Organization Controlling Potential Chemical Warfare Materials," SIPRI Monograph titled, "Chemical Disarmament: Some Problems of Verification," 1973.

Mr. ZABLOCKI. Thank you, Mr. Pittaway.

GENEVA PROTOCOL—WITH OR WITHOUT RESERVATION?

I wish to thank all three of the witnesses for their very thoughtful and thought provoking, highly technical presentations. Your papers and your oral summaries point up the very complex problem we are trying to deal with. It appears that much of the problem, political particularly, rests with the definition as to what is and what is not included in the protocol of 1925. However, a point emphasized by Mr. Pittaway is that it would not be in our country's national security interest to unilaterally disengage from any chemical warfare capability. Indeed, to do so would put us at the mercy of those who did not disarm chemically. More than that, it would make us dependent on nuclear retaliation, and that, as you have stated in your final summation, is unthinkable.

But the question does arise: Is it in our national security interest to ratify the protocol with or without reservations? I do not believe this particular question was specifically dealt with and therefore I would like to have each of the witnesses very briefly give their point of view on the advisability of ratifying the protocol of 1925, with or without reservation.

I will start with Dr. Meselson.

IMPORTANCE OF RATIFICATION WITHOUT RESERVATION

Mr. MESELSON. Mr. Chairman, I think it would be advisable to ratify without any special reservations or exceptions. The protocol is not a disarmament treaty, it is a no first use treaty. It has no necessary effect whatever on stockpiles of anything. Beyond that the two agents in question, herbicides and riot gas, are not weapons of any decisiveness in foreseeable confrontations with our major adversaries.

We would suffer no loss in national security by renouncing the option to strike first with tear gas or with herbicides. The use of these weapons against a possible major adversary like the Soviet Union would be irrelevant in the context of the kinds of weapons that we have arrayed against one another.

Ratifying the protocol without special exemptions for riot gas or heribicides would, in contrast, enhance our long-run security by providing a clear bench mark, a clear understanding.

Mr. ZABLOCKI. Mr. Robinson.

Mr. ROBINSON. Mr. Chairman, with respect I think that the question of how the United States approaches the Geneva protocol, it is not a thing that I, as a foreigner, should comment on, except to express my own personal preference that the fuller the interpretation the better when made by this country.

THREE COUNTRIES OPPOSED U.N. RESOLUTION

Mr. ZABLOCKI. Would it not be true though that since only three countries opposed the 1969 U.N. resolution which broadly interpreted the protocol to include herbicides and other toxic agents including tear gas that our position now may be different or should be different. Perhaps I should not ask that of you, Dr. Robinson, but I shall Mr. Pittaway. If you care to comment, I welcome it.

Mr. ROBINSON. Merely to express the view that it is unfortunate that the United States has become so isolated on this issue of the interpretation of the protocol. As you remarked, the United Nations voted with only three votes against on the particular issue of definition, leaving the United States exposed into a position where it still is.

Mr. ZABLOCKI. Of course, as noted in testimony both today and yesterday, the three countries who voted as they did were at that time employing the type of chemicals that were to be included in the protocol. Their position might therefore have been based on the situation at the time. Today we are not in any confrontation and we are not in Vietnam, the situation presents itself in an entirely different climate and I would hope that we will take another look at it.

Mr. ROBINSON. I would agree with that entirely, Mr. Chairman.

Mr. ZABLOCKI. Mr. Pittaway.

CW USE NULLIFIED BY DEFENSIVE MEASURES

Mr. PITTAWAY. Well, Mr. Chairman, the incapacitating agents at one time perhaps could have played a very interesting role in close support ground combat. The use of incapacitating agents in Korea, for example, might have had an interesting effect on the amount of casualties we suffered there. The attack of strong points is always the highest casualty producing activity for infantry. But if your opposition is equipped with masks there is no particular advantage and given that any kind of a conflict that we would be involved with now where we would be using incapacitating agents, we can be almost completely assured that our opponents would be equipped with masks. I think this nullifies any advantage that could have been gained from that approach. Also given the kinds of incapacitants currently available, as we have found from our Vietnam experience, they can be resisted to extraordinary concentration levels by people not wearing masks when they are sufficiently motivated by fear of death.

Mr. ZABLOCKI. The question, Mr. Pittaway, is if the United States would ratify the protocol of 1925 without reservations this would not in any way prevent us from being prepared for any eventuality.

Mr. PITTAWAY. That is correct and I am getting to the point. I wholeheartedly support Dr. Meselson's position. I think that we should ratify the convention. I think that is an excellent step to take, and

I don't think that we are materially losing anything by doing so. I think we should do so without reservations because of the reasons given above.

UNITED STATES SUPPORTED 1969 BW CONVENTION

Mr. ZABLOCKI. Mr. Robinson, may I have your opinion as an outsider as to the sincerity of the United States at the 1969 summer session of the CCD at which the United Kingdom presented a draft convention establishing a comprehensive ban on the development, production, stockpiling, and the use of biological methods of warfare. The United States assisted in this effort, supported it and was associated with it. To what extent has the image of the United States been improved with that particular activity of the United States in concert with Great Britain?

Mr. ROBINSON. I think, Mr. Chairman, without any doubt at all that the Biological Weapons Convention would never have been concluded without the active support of the United States in the negotiations. It is the hope of the people in Geneva that the United States will soon take a similar lead on the question of chemical weapons. It is my understanding that the U.S. delegation at Geneva has been waiting since the middle of 1972 for a substantive updating of its negotiating position. I think the fact of this delay indicates the low priorities that are accorded to chemical warfare policy at top levels.

REASONS FOR SUPPORTING PROTOCOL WITH RESERVATIONS

Mr. ZABLOCKI. Being the devil's advocate, do you believe the U.S. position that to exclude herbicides and tear gas from the intent of the protocol of 1925 was influenced by the fact that those chemicals were not as widely used or even known in 1925?

Mr. ROBINSON. Mr. Chairman, on this question I am not an expert, but it is my understanding in some of the League of Nations studies at the time of 1925, 1924, before the protocol, there was some form of reference to antiplant agents. My recollection may be faulty on this, and I should defer to Mr. Meselson.

Mr. ZABLOCKI. If my memory serves me correctly, debate was not extensive on that score so there was no clarity of definition at the time of the tabling of the Geneva protocol of 1925.

Mr. ROBINSON. Yes; Mr. Chairman, I think that is correct but I think one needs to respect their wisdom in deliberately drafting the protocol to be forward looking. The draftsmen used language which would encompass future developments.

TAKING A MORE PROGRESSIVE LOOK

Mr. ZABLOCKI. Nevertheless some of the signatories used chemical warfare after signing the Geneva protocol. Of course, that does not mean that we should not take a more progressive look in 1974 and forget what was the interpretation definition of the past in order to move forward.

I didn't mean to go to such an extent of getting your opinion. We are deeply interested in an outsider's view of the U.S. position but

at the same time we want to have our position reviewed and go forward.

Thank you very much.

Mr. Biester.

Mr. BIESTER. Thank you, Mr. Chairman.

I was answering the quorum call and I only came in at the very tail end of your colloquy with Mr. Pittaway. I assume it was on the question of disabling agents as opposed to lethal agents and their use in combat. Am I correct in that?

ON THE HUMANENESS OF DISABLING AGENTS

Mr. PITTAWAY. I started out essentially by giving a rationale for why I was going to say finally that I thought we should accept the signing of the Geneva protocol without reservations and essentially that we have no advantage to give up as far as the incapacitants were concerned. While I did not address the herbicide issue, I think that we have no real advantage to give there either.

Mr. BIESTER. I wonder if we might explore that whole question of disabling agents however for the moment. The chairman has been the devil's advocate for a moment and I wonder if it is appropriate for me to ask the questions which I suppose really are to some extent within the range of unthinkability today.

To what extent can the use of disabling agents in combat be a more human operation than shells, bullets, shrapnel, bombs and the rest?

Mr. PITTAWAY. Are you speaking now of agents like BZ?

Mr. BIESTER. Yes; why is that worse than the shooting?

Mr. PITTAWAY. The underlying concept there is a very appealing one, that one should very much like to have an agent that would anesthetize an enemy so that you could capture a position without resorting to killing him, to penetrating him with bullets or what have you, a very appealing idea, and it was precisely in those kinds of terms that I think the incapacitants were originally being looked at.

SIDE EFFECTS OF INCAPACITANTS

If such an incapacitant existed, then our whole frame of reference might change but such incapacitants do not exist. The incapacitants as we know them today have most unpleasant side effects. You are talking about LSD and that was one of the proposed incapacitants, of BZ as Dr. Meselson pointed out. They cause irrational behavior.

Mr. BIESTER. For how long?

Mr. PITTAWAY. Well, for how long is not really perhaps too much of an issue. No military man wants to face any set of troops that is behaving irrationally, and in fact irrational behavior can also take the form of not giving up when it would be prudent to give up. Also, irrational troops that have access to atomic weapons can perhaps use those atomic weapons in a way that you would not want them to use them and that under rational sets of conditions he would not use them. So it is the element of irrationality that is introduced into the situation that makes those kinds of incapacitants very unattractive.

Mr. BIESTER. Beyond the state of the art to develop an incapacitant that does have this side effect?

Mr. PITTAWAY. I am not qualified to answer but perhaps Dr. Meselson would like to address that issue.

Mr. BIESTER. Is that beyond the state of the art?

Mr. MESELSON. Right now, yes. You cannot say in the future it cannot be done but the search for incapacitants of that sort has not produced anything acceptable.

THE TIP OF THE ICEBERG

I think it is important to not lose sight of the fact that what we are talking about here is whether or not we are willing to give up the option to institute the use of CS in war. As far as whether a CS makes war more horrible or less horrible, I think the answer there is it does neither. The concern about CS has nothing to do with the effects it has on war. The concern has to do rather with the importance of holding the line against far worse sorts of chemical warfare, against an entire new dimension of warfare. On that note, what we are talking about here is the tip of the iceberg in the sense that the entire technology of killing or of controlling life by understanding its mechanisms is a technology we are just now beginning to enter and the question we are asking here is will we set up a taboo—the taboo that says as we learn how to control and manipulate the living process in the most profound ways that mankind will not use this kind of knowledge for purposes of war. In my mind this may end up being the most important question behind our policy with regard to the use of what is really a trivial weapon with very few effects on war either good or bad, namely CS.

MAIN FEAR ABOUT CHEMICAL WARFARE ESCALATION

Mr. BIESTER. Our general classification then would be the area not just of chemical warfare or biological warfare but warfare which is based on some process of manipulation of the central nervous system of a potential combatant?

Mr. MESELSON. A manipulation of more than that. In the May issue of the National Academy of Sciences there will be an article on the successful implantation of genes from a frog into a bacterial cell where they reproduce and make the products that would normally be made in the frog. The technique by which this is accomplished can be done by an intelligent high school student and it is applicable to transferring genes from one species to another species. I can't spell out for you too precisely why we ought to worry about that but I can tell you that I and many of my colleagues share an unease that we are on the eve of an enormous revolution in the changes that we can make in living organisms. If this knowledge is not controlled—although I don't think anybody can spell out a believable scenario today—one has the very uneasy feeling that it takes us into a future that could be very ugly indeed. To me, this provides a compelling reason for setting up the most durable safeguards that mankind will not use his knowledge of living systems in order to control or destroy them for military purposes.

Mr. BIESTER. Again I am still searching for the generalization. We are talking about not just simply chemical or biological warfare, not just manipulation of the central nervous system by some pharma-

cological technique, we are talking about warfare based on a scientifically created basis to direct and manipulate great numbers of potential combatants?

Mr. MESELSON. Precisely.

Mr. BIESTER. Thank you.

Mr. ZABLOCKI. Mr. Fraser.

Mr. FRASER. Thank you, Mr. Chairman.

U.S.S.R. POSITION ON VERIFICATION

One of the things that has come out so far which I found to be most interesting was your statement, Mr. Pittaway, that the Soviets have expressed in the negotiations in Geneva—or perhaps it was somewhere else—the notion that verification was a course worthy of pursuit. I am not paraphrasing your statement accurately but you indicated that the Soviets expressed some such general position. Could you perhaps simply restate what you understand their position to be at the moment?

Mr. PITTAWAY. I realize that what you have said is the sense of what I quoted and I realize that my involvement with these kinds of negotiations have been vis-a-vis technical experts. The technical experts involved have also been involved on the Soviet side, in the negotiations at Geneva. It is my belief that nothing that has been said in these technical discussions is in any way different from Soviet policy in this area inasmuch as it has been made perfectly clear in all of these discussions that at no time do any of their people ever express anything that is not within Soviet policy and it has been said to me on several occasions that, in fact, they wish to see some sort of a verification system and they want a verification system.

They are studying various kinds of approaches to the verification system and they have seized on all of the ideas that we have put forth in these areas with a great deal of interest and have wanted to continue the discussions at length and explore these areas. The problem is in coming up with an approach where the degree of intrusion required for verification is one they can accept.

ONSITE INSPECTION A CENTRAL ISSUE

Mr. FRASER. Do you know if, within the range of verification procedures they are expressing interest in, they include onsite inspection?

Mr. PITTAWAY. Two years ago, in a series of discussions that we were having at that time, they expressed a willingness to undertake the concept that an international group dedicated to the purpose would be permitted some access within the Soviet Union to make onsite inspections. Later discussions after that—a year later—they had moved slightly away from that and did not really want to discuss the international verification issue at that time, but as recently as 2 weeks ago at the Pugwash meeting in Helsinki, that door was opened again. Since Dr. Robinson was there at that meeting, perhaps he can speak to that point and what academician Reutov really had to say about that, since I would have to give it to you secondhand.

Mr. FRASER. Mr. Robinson, I would be very interested in this because this onsite inspection matter has been a central issue in negotiations

with the Soviets not only in the field of chemical arms control but in nuclear arms control. For the moment, on chemical arms control, what can you tell us about the Soviet position regarding onsite inspection?

PUGWASH STATEMENT ANTICIPATED

Mr. ROBINSON. Well, sir, I think Mr. Pittaway was correct when he spoke of the state of the negotiations at the formal level at Geneva. There has been quite a substantial polarization of attitudes on the verification question. What one has to remember is that the chemical disarmament negotiation process involves some highly technical questions, a lot of technicalities for people to grasp. To cope with this, there is a whole layer, as it were, of informal consultations that take place between the technical people on all sides. These support, and sometimes eventually feed into, the CCD talks. I think Mr. Pittaway was referring to one such exercise of this type.

On balance, sir, I would be reluctant to discuss in too much detail what took place at this particular meeting. It was one of the fora where private discussions take place between the technical people. What happens is that after such meetings a statement is issued to which all the participants put their names, and in this case the statement is, I think, still in the process of publication. I think one should wait until it has been published to comment in any more detail on it.*

These are early days. There has been a sign, a form of action which might be interpreted as a signal, but one does not want to blow it away at this stage.

Mr. FRASER. You suggest that the statement that may be published as a result of the Pugwash conference may touch on this question?

Mr. ROBINSON. I believe it will, sir.

SOVIET NEGOTIATING POSITION

Mr. FRASER. Without trying to overdraw the conclusions, taking into account Mr. Pittaway's description of the Soviet negotiating position, there is reason to be encouraged with the prospect that the Soviets are willing to consider, in looking at the verification problems, the possibilities of onsite inspection?

Mr. ROBINSON. I think it would be fair to say that this was a very good meeting at which a lot of ideas were put in, were discussed, were taken a step forward, and the people involved were very encouraged by this. We hope that in a few months other things may develop from it. This underlies the point which came out very clearly, if I might digress, in what Dr. Pittaway was saying.

Verification, as he says, involves difficulties and complexities which requires a lot of study. But there is now light at the end of the tunnel. He is suggesting that it is a very long tunnel, that it will take time to get down to the other end: and this is why I was urging, in my opening statement, that we should not foreclose on this particular option; we should not move into an area on the weapon side which would shut off prospects of going further along that tunnel.

Mr. FRASER. I would like to come back on that point to you, Mr. Pittaway. You don't refer, so far as I could find in your statement—

*The report of the Pugwash Chemical Warfare Workshop in Helsinki appears in the appendix on page 374.

although I read it rapidly while you were summarizing it—to this policy question of our moving ahead now with the production of the binary chemical agent. You have heard the discussion here suggesting that this raises some questions, first with respect to the ultimate position on controlling or eliminating chemical stockpiles.

There is also a related issue as I understand it as to whether this new binary agent, while it may be safer to store and transport, is any more effective than what we have currently in our arsenal. Could you comment on those two aspects?

Mr. PITTAWAY. Yes.

I may not be speaking from fully informed opinion at this point but I would like to say that I think going into the binary weapon system is an attempt to apply a logical solution to a nonlogical problem in which I would define——

Mr. FRASER. A logical solution to a nonlogical problem?

Mr. PITTAWAY. Yes, which I would define logical as being based on reason, nonlogical on a mixture of emotion and reason and illogical as being emotional only.

There is a major problem in moving nerve agents around the country and I think that that is a nonlogical situation. There are reasons to be fearful of such movements but I think there is a lot of emotional content that is involved there to.

Binary weapon systems it seems to me is merely an attempt to apply logic into that situation and it does not really address some of the core issues that are involved. Movement of these weapon systems are of course not only a problem within this country but also their movement into and out of the country. So to my mind it is not clear that that logical approach is in fact a viable solution to the problem that you are trying to address at this point. Logic seldom prevails in nonlogical situations.

FIELD TESTING OF BINARY AGENTS

Now, with respect to the production of binary agents themselves, I would also caution, on the basis of my prior experience in the field, that there is some element of risk involved with respect to the production of this weapon system without it having been thoroughly tested and evaluated in field tests. We have had one very sad national experience in this area already and that was when we put all of our faith in lewisite as a chemical agent after World War I, and that was done on the basis no testing essentially. When we finally got around to testing that material we found out when it was disseminated into the atmosphere it was totally ineffective as an agent.

Mr. FRASER. You are suggesting that the binary system has not been adequately field tested?

Mr. PITTAWAY. I am suggesting that that may be true, and it would be worthy of your looking into. As far as I know, there have been no open air tests for some time. Consequently, the binaries have not been tested. Based on my own prior experience in trying to find stimulants for these agents on which to conduct various kinds of technical evaluations, no stimulant exists that is adequate for the evaluation of all of the factors that are involved in the delivery of

this munition and its dissemination in the field. Therefore, if it has not been tested, I question the advisability of expenditure of the funds in order to develop the weapon system.

THE QUESTION OF NUCLEAR "FIRST USE" RETALIATION

Mr. FRASER. I have one last question that goes to your urging that we consider the importance of a capability in the chemical weapons field in the absence of an arms control agreement.

Why do you look, for example, at the use of tactical nuclear weapons on the battlefield as of such significantly different seriousness or evoking significantly greater consequences than the use of chemical agents which have been banned by international agreement? Don't they both convey—I think, as Mr. Owens or one of the others stated, a degree of intent that would make a limited nuclear response both logical and one that might be anticipated? If what I am saying were true, one would think nuclear weapons would be quite an adequate deterrent, or as adequate a deterrent as having the chemical capability.

Mr. PITTAWAY. Let me address a response, and, if I do not fully answer your question, you can ask it again.

I think part of my fear here is that this is very much related to the arguments used for not permitting riot control agents to be excluded from chemical warfare bans. Even though we have substantial numbers of tactical nuclear battlefield weapons, and we continue to develop those with smaller and smaller yields so that their area of effect is confined, I am not so sure that we are really going to be the first to initiate nuclear war, and I am not so sure that others will be willing to do so either, but I don't have any real knowledge on which to base that. I just think it is a step similar to deciding that you are going to conduct chemical warfare, that world opinion is going to turn very much on whoever does it first, and I don't think that the military people on either side are perhaps really all that committed to it. I don't know.

The chemical argument on the use or nonuse of incapacitants is that once you start, escalation may occur until lethal agents are in use. I think that my fear as far as nuclear weapons are concerned is if you are in a nonnuclear situation where chemicals are employed, and if you have to retaliate by nuclear force, where will it end: on the battlefield, or when we are attacking each other's cities, which would be a world distaster? I rather would not take the first step, and I would not want to be in a position where that is the only means of retaliation available.

CW FIRST-USE AGAINST NONSIGNATORIES

Mr. FRASER. I have the impression that it is precisely that uncertainty that constitutes the effective defense of Western Europe when one speaks of the possibility of chemical weapons or of any other kind of an attack. In other words, it is the uncertainty as to the response by the West that is considered to be an effective deterrent to any Soviet initiatives. I am not suggesting they are about to do it anyway, but in terms of dealing with potential problems, I don't see that this one variation that you introduce significantly alters the basic problem

we face there. The number of weeks that our allies are capable of maintaining a conventional war in the central battlefront apparently is quite as limited as is ours, and the likelihood of moving to nuclear weapons remains a very high, a substantially significant possibility—well, I don't know as this is worth pursuing more at this moment, but I was interested in your views.

Thank you.

Mr. PITTAWAY. I will make one further comment on that at this point.

If we are in a nuclear kind of an engagement, and we have not signed the Geneva protocol, the Soviet reservation on their signature is that they are free to use that chemical weapons system against any nonsignatory power.

Mr. FRASER. That is the point I hope to bring out, and that is the way I read the protocol. As long as we have not signed it, no country is barred from first-use against us.

SOVIET DOCTRINE OF COMBINED USE—CHEMICAL AND NUCLEAR

Mr. PITTAWAY. And the Soviet military doctrine is the combined use of nuclear and chemical.

Mr. FRASER. Well, that is not very encouraging. If they are going to use chemical and nuclear at the same time, then we have already crossed the nuclear threshold.

Mr. PITTAWAY. For the sake of argument let's say that we concede that the nuclear side of it is inevitable, if we don't sign the protocol, or perhaps even if we do for that matter, if chemical warfare is used against us in the nuclear engagement, and we have only nuclear to respond with, we are in sad shape—very sad shape.

Mr. FRASER. Yes; but that gets into other questions which I think are beyond the scope of our hearing now.

Thank you, Mr. Chairman.

Mr. ZABLOCKI. Mr. Harrington.

Mr. HARRINGTON. Thank you, Mr. Chairman.

I hope that I am not intruding on Congressman Fraser's time.

Mr. FRASER. I have been using the chairman's time.

ILLUSORY BENEFITS OF SALT TALKS

Mr. HARRINGTON. I want to preface this by suggesting that I am not a member of this subcommittee, so I hope you will understand the naivete which may come through. I am interested in the subject area in general, and would like to try to predicate my own concerns by paraphrasing parts of an article that appeared in the New York Times this morning—an article that I think to a degree symbolizes my concern and prompts my being here. It is by Daniel Lang, and I don't know much more about his background other than what is at the end of the piece.

Mr. Lang is talking about the illusory benefits of the SALT talks, that they are anachronistic, and not getting to the basic and fundamental concern, which is more toward actual disarmament, rather than leaving it to a degree an almost endless discussion of the ways in which we can arrive at solutions to some of these problems.

I would like to quote from this article and ask you to comment on some of these observations, if you would. I can't help but feel that many of the people in the Congress that I have dealt with and had occasion to peripherally to discuss this with, have been given to disinvolve themselves to a maximum degree, because of the highly technical nature of the many facets to the problems that are discussed this morning, problems that are part of a broader range of topics to be discussed over a long period of time.

In talking about the SALT talks, Mr. Lang writes:

> There is yet another unfortunate aspect of the talks. Through the self-imposed stress on technical matters, the conference is conveying—no, reinforcing—the impression that the general safety is strictly a matter for experts. This makes for a mistaken humility on the part of ordinary citizens. They dare not challenge the mentality of power politics; they dare not speak up for what they really want.
>
> Heads of state have preached this for years but in practice their representatives haggle over items that are detours from the road to disarmament, partial or complete. Lip service is paid to disarmament, but if one discusses it with negotiators, or their superiors, as I have done in the past, one elicits a look reserved for those who dream of pie in the sky.

THE CONFLICTING FUNCTIONS OF ARMS CONTROL

I can't help but feel, even if it is overly emotional, that to a degree this article does speak to a genuine concern, as 48 years and 10 months after the Geneva protocol was arrived at, we find ourselves, two generations later, in a discussion of this kind. While I have ready appreciation for the lifetime spent accumulating specific knowledge, I think that there is something essential to the kind of observation that is made by Mr. Lang. I would like you, if you would, to address yourselves to what it is that had us, within 2 weeks of May of 1972, when the SALT talks were hailed as a breakthrough in the generation-old impasse with the adversary from the East, listening to Melvin Laird before the Armed Services Committee asking, in the bargaining chip analogy, for additional moneys to attempt to further accelerate weapons programs not covered in those SALT agreements. In this instance, I happen to think the people are ahead of both us and the experts, and I would like to have either of you comment any way you like.

Mr. ROBINSON. If I might make one comment on that, I think that what we have been seeing in the 1960's—I speak from my rather distant experience with arms control problems—is that attitudes toward armament, disarmament, and arms control have diverged in various countries. You get the situation, on my reading, that arms control in this country is seen solely as a means for mitigating some of the adverse consequences of resting national security on military strength.

I think in President Nixon's latest statement on foreign policy to Congress, he remarks that one of the functions of arms control is to restore stability to international relations destabilized by developments in military technology. I think this emphasis on arms control as a complement to military strength rather than as a substitute for it is the root of popular discontent. People get the impression that a raw deal is being pulled on them. In this regard there is one rather significant aspect of the chemical disarmament talks: Here we have for the first time, a disarmament measure, an act of real disarmament,

being proposed as an arms-control objective. A conflict of fundamentals is involved because in the chemical talks the role of arms control is being elevated up from that of a complement to military strength to that of an actual substitute for it.

That is a rather tangential comment on the matters you are raising.

EFFECT OF CHEMICAL WARFARE CONTROL STALEMATE

Mr. HARRINGTON. It is appreciated for the initial insight. I intend, without being remotely able to address it with the same insight, to counter that this perceived conflict is a substitute for looking at the problem more clearly. That is what I am most concerned with—the irony of a major power, two generations later, finding itself still at this point in chemical warfare arms control.

I don't think it is a failure from the point of view of those who are narrowly concerned with the problem, but a failure of those who profess to want to exercise leadership and to educate to do a more effective job. I think that is a mutually shared burden. I don't think it is exclusive.

Did you have a comment, Mr. Meselson?

Mr. MESELSON. Yes. In areas of nuclear policy, even in areas of lethal chemical policy, there are very serious issues of national security.

Mr. HARRINGTON. I hope that we can find a paraphrase for that term one of these days, Mr. Meselson.

Mr. MESELSON. It means an awful lot of people could be killed if it goes wrong.

But when you get down to a question of riot gas, and herbicides threatening to erode the clarity and the authority of the Geneva protocol, if you are saying you are discouraged, I have to agree with you because that is nitpicking. Tear gas in a war, or herbicides in a war, don't matter to our national security. What does matter is establishing the strongest barriers against the possible chemical and biological wars of the future.

Mr. HARRINGTON. It tends to reinforce the central theme of our absent but often cited author.

TECHNICAL NATURE OF CHEMICAL WEAPONS

Mr. PITTAWAY. I think my comment at this point is that as a technical person in this field, I have always felt that our role was to try to aid and assist those who are in a position of leadership or a position of policymaking, to assist them in the execution of that policy and the exercise of that leadership. It has been my experience over the period of the last 10 years that it is extraordinarily difficult for technical people to obtain an audience at any level, whether it is within the Government or outside the Government, to make a contribution, that very frequently those contributions are not sought at all, and one has to fight very hard in order to have an audience to make them to.

I think that the technical people would be more than willing to address the general public or governments or what have you in proposing solutions to any question that they want to propose. I think that the technical feasibility of coming up with a methodology for carrying out any kind of policy that you want to name in the area of arms control or in the area of verification of treaties and so forth is possible

as long as you are willing to let them address the problem and give them an audience for their answers.

I share some of the points that Dr. Robinson was making earlier with respect to substituting arms control for armaments. I think that it is a step in the right direction. I think that it is a very possible thing to do. I think that there are technical methods for arriving at a set of arms control verification procedures in the chemical area that given the right kinds of political commitments everybody would be happy with, but it is very difficult to find somebody that is willing to devote the resources into the technical area in order to make those solutions possible.

Mr. HARRINGTON. I appreciate the chance to presume on your time.

REASONS FOR NONRATIFICATION OF THE GENEVA PROTOCOL

Mr. ZABLOCKI. If I may just pose a question that was asked in the subcommittee's hearings on this same subject 5 years ago as to why the Senate did not ratify the protocol of 1925 when the agreement of 1922 went through the Senate without any problem. Prof. George Bund of the University of Wisconsin School of Law ventured these reasons: One was that the Department of State, then Secretary of State Kellogg, did not make any effort to gain support because he thought the protocol of 1925 would sail through and be ratified in the Senate without any problem. Then, too, the Army Chemical Warfare Service, the American Chemical Society, the veterans organizations and segments of the chemical industry all opposed it. But the real argument in the Senate was that the protocol would be ignored in time of war and that in any event poison gas was more humane than bombs and bullets. As we hear today, this may be the reason we should not discard the possible use of chemical warfare. But the main reason was that cited by an American representative to the United Nations in 1952, and I quote:

> When the Geneva Protocol was submitted to the Senate for ratification America was retreating rapidly into isolationism and neutralism and feared any involvement with the League of Nations and any treaties originating from Geneva.

RETURN TO ISOLATIONISM?

Today we find the United Nations discredited to some degree. There is a wave of feeling in this country that we should get out of the United Nations, get the United Nations out of the United States. There is a lack of faith in the United Nations, and there is some neoisolationism in evidence. Therefore, the question that we must ask ourselves is, are we going to find a repeat of history in 1974 when the protocol of 1925 is again before the Senate, that the fate may be the same as it was in 1925?

I would hope not, but there were these reasons that were given in the past. In your opinion, gentlemen, are these reasons valid today? Do you find that isolationism or lack of public interest may be the reasons the Senate will not act?

Mr. MESELSON. Mr. Chairman, I believe that there is support for the protocol. The newspapers that I read, the Boston newspapers and the Washington newspapers, have given the protocol a great deal of favorable comment. If there is a difference between now and 1926 it might be that the protocol has a great deal of support. I have not heard

anyone speaking against it, but rather the danger is that we may have become so involved in nitpicking about something that is basically unimportant that we might lose sight of what is important.

Mr. ZABLOCKI. Mr. Pittaway.

PUBLIC ATTITUDE TOWARD CW

Mr. PITTAWAY. Well, I also offer a disclaimer of being a spokesman for general public opinion, but I would like to make the observation that if this meeting had been held 2 years ago that we might have been forced to hold it in a public colosseum rather than in this committee room, and I see the absence of general public interest in this area that would have been present 2 years ago when we were still in the war in Vietnam.

Mr. ZABLOCKI. We held hearings in November 1969, in which there was interest. In fact, as a result of those hearings the administration was moved to agree to biological warfare agreements.

I don't want to sound egotistical, but I hope that your observation, Mr. Pittaway, that there is not ample evidence of public interest this morning, does not necessarily mean that there is not widespread interest of the public as well as those in Government, particularly people in Congress.

Mr. PITTAWAY. I would certainly hope that that is true. I want it to be true.

Mr. ZABLOCKI. I would like to ask another question of you, Mr. Pittaway. In your statement on page 3 you flatly state that, "* * * technical procedures now under consideration can provide assurance of compliance provided the political problems can be solved."

POLITICAL PROBLEMS

What exactly are those political problems? Are they domestic, international, or both?

Mr. PITTAWAY. Primarily they relate to agreements with respect to the degree of instruction that will be permitted for the verification of an agreement. Let's say that given the assumption that the chemical warfare treaty would require some verification means then the verification problem can be solved if we can get some political agreement with respect to the degree of intrusion that will be permitted.

There is going to have to be some intrusion at some level to do some very specific kinds of things. There has to be some audit function exerted if there is to be a verification procedure. Our technology today would still require that someone physically be able to go to a predestined, prenamed, geographic location and look and then go away, and if we can move that far politically then we can solve the rest of it.

Mr. ZABLOCKI. Mr. Harrington.

Mr. HARRINGTON. No.

Mr. ZABLOCKI. Well gentlemen, I want to again assure you that your presentation was most valuable. It will take some time to thoroughly digest your very technical and comprehensive statements. I can assure you that members of this subcommittee and the full committee and I hope Members of the Congress as a whole will carefully study your recommendations.

Thank you very much, gentlemen.

Mr. PITTAWAY. Thank you.

Mr. ZABLOCKI. The subcommittee stands adjourned until 10 o'clock Tuesday morning, May 7, when we will hear two additional private witnesses: Prof. Richard Baxter, professor of law, Harvard University, and president of the American Society of International Law; and Dr. Bernard Friedman, president, American Chemical Society.

The subcommittee stands adjourned.

[Whereupon, at 1:20 p.m. the subcommittee adjourned, to reconvene at 10 a.m., Tuesday, May 7, 1974.]

U.S. CHEMICAL WARFARE POLICY

TUESDAY, MAY 7, 1974

HOUSE OF REPRESENTATIVES,
COMMITTEE OF FOREIGN AFFAIRS,
SUBCOMMITTEE OF NATIONAL SECURITY
POLICY AND SCIENTIFC DEVELOPMENTS,
Washington, D.C.

The subcommittee met at 10:10 a.m. in room 2200, Rayburn House Office Building, Hon. Clement J. Zablocki (chairman of the subcommittee) presiding.

Mr. ZABLOCKI. The subcommittee will please come to order.

The Subcommittee on National Security Policy and Scientific Developments continues its hearings on U.S. chemical warfare policies.

This morning we are pleased to welcome two distinguished experts on the subject:

Prof. Richard Baxter, professor of law at Harvard University, and president of the American Society of International Law; and Dr. Charles C. Price, a past president of the American Chemical Society, and Benjamin Franklin professor of chemistry at the University of Pennsylvania. Dr. Bernard Friedman, current president of the society and originally scheduled to be our witness today, was unable to be present.

Gentlemen, we are honored to have you here and to benefit from your insights into this challenging subject of chemical warfare.

Professor Baxter, if you will proceed first, please, to be followed by Dr. Price. We will hear each of you separately and then address our questions to you as a team.

Professor Baxter, you may proceed.

STATEMENT OF RICHARD R. BAXTER, PROFESSOR OF LAW, HARVARD UNIVERSITY

Mr. BAXTER. Thank you, Mr. Chairman.

I am a professor of law at Harvard, president of the American Society of International Law, and editor-in-chief of the American Journal of International Law. I served as a member of the U.S. delegation to the First and Second Conferences of Government Experts on International Humanitarian Law which were held in Geneva in 1971 and 1972. I also served on the U.S. delegation to the Diplomatic Conference on International Humanitarian Law which was held in February and March of this year in Geneva.

The views which I express are naturally my personal ones as a private citizen.

I must say that those of us who are interested in the law of war and in CBW in particular were highly satisfied with the Presidential initiative taken in 1970 with regard to the Geneva protocol. Now it would seem that the "native hue of resolution" has been "sickled o'er with the pale cast of thought" and that the matter has been lost somewhere between the Senate and the executive branch.

Several years ago when this issue was very much alive, as I hope it will indeed be again, Professor Buergenthal and I examined the drafting history and subsequent practice under the Geneva protocol in order to determine what the proper position was in the interpretation of the instrument with respect to irritant gases, which I think are called in military terminology "riot control agents," and chemical herbicides.

Our examination of the record—the drafting of the Geneva protocol, the ordinary meaning of the instrument, and the subsequent practice—led us to believe that irritant gases do indeed fall within the prohibition of the protocol and that the same, although the case is somewhat weaker, is true of chemical herbicides. Chemical herbicides do seem to be forbidden by the protocol, although there is not very much evidence on this score.

So far as irritant gases are concerned, if one looks to the ordinary meaning of the words of the Geneva protocol, the term used is "asphyxiating, poisonous or other gases, and * * * all analogous liquids, materials or devices."

AMBIGUITY OF FRENCH TEXT

The waters have been somewhat muddied by the fact that the French text,* instead of referring to "other gases," refers to "gaz * * * similaires"—"similar" gases instead of "other" gases—which might suggest that the gases must be similar to asphyxiating or poisonous gases. It is then argued that tear gas is not included within the definition as it appears in the French text.

However, if one looks to the subsequent practice of the parties, which is the preferred method of interpretation for the purpose of international law, rather than looking to the drafting history, one finds that in the 1930's disarmament negotiations the French said that there was no discrepancy between the two texts, that the English and French texts were supposed to mean the same thing, and that in the French understanding tear gas was likewise prohibited by the Geneva protocol.

The most recent evidence that we have had on this score is the resolution of the General Assembly which was adopted in December of 1969 in which the General Assembly gave an extremely comprehensive interpretation to the Geneva protocol, so that it would indeed cover irritant gases and chemical herbicides.

This General Assembly Resolution 2603 A was adopted by a vote of 80 in favor with 3 opposed—the United States, Australia, and Portugal—and 36 abstentions.

The drafting history too, if one drops down to the last aid to interpretation which is recognized under international law, bears out that

* A copy of the French text appears in the appendix on p. 371.

the Geneva protocol was intended to be given a very broad interpretation.

HERBICIDE ISSUE NOT CLEAR

So far as chemical herbicides are concerned there is much less subsequent practice—subsequent in the sense of being after 1925. If one looks to the drafting history, one finds that biological antiplant agents were mentioned by France and by Poland in connection with the drawing up of the Geneva protocol of 1925, so that herbicides can be said to have been within the contemplation of the conference, drawing up of the protocol. And it would seem that if the participants thought of biological agents and intended to include these, they would likewise have contemplated chemical herbicides, were that possibility to have been presented to them.

Again General Assembly Resolution 2603 A of December 1969, places this broad interpretation upon the scope of the Geneva protocol—the best contemporary evidence that we have of the meaning of the instrument.

The position which the executive branch has taken on this matter seems to me to have been the worst possible solution, a solution which provides no real legal protection to the United States and which perpetuates the uncertainty. The idea is that in effect the executive branch would whisper in the ear of the Senate that chemical herbicides and what the military call "riot control agents" were not within the contemplation of the Geneva protocol, but this communication would stop short of the Senate and would not be transmitted to the depositary of the treaty or to the other parties to the treaty.

NEED FOR COMMON INTERPRETATION ON PROTOCOL

Now, I can understand the importance of arriving at a common interpretation of the Geneva protocol. Certainly a variety of views have been expressed, although the predominant views is, as I have indicated, that chemical herbicides and tear gas are within the prohibition of the protocol.

The danger if this uncertainty remains, is that if one state such as the United States or Australia or Portgual, were to say that tear gas is permissible and were to use it, the other side would then say that there has been a clear violation of the Geneva protocol, will feel liberated from the obligations of the protocol, and will consider itself entitled to resort to any sort of gas or herbicide that it may think proper to employ.

So it is of paramount importance that we arrive at some common understanding on this point.

Various devices have been suggested, for example, that there should be a new conference to draw up a protocol to the Genera protocol which would spell out that it does apply to tear gas and to chemical herbicides. It has been suggested that the United States should assume this obligation not to use tear gas and chemical herbicides conditionally upon a reciprocal understanding by other states of the scope of the protocol. It has been proposed that there should be a polling of other parties to the Geneva conference. I think that the probable result of any such initiative is that other states would look upon it as unnecessary. They simply would not play, and the United States

would be faced with a compounding of the ambiguities of the situation through the existence of differing interpretations as some states cooperated with the United States and many others did not.

INTERNATIONAL COURT OF JUSTICE OPINION

It has also been suggested that there should be advisory opinion of the International Court of Justice on this point. This opinion would have to be requested by the General Assembly or the Security Council. It would be handled as a political question in those bodies. Then, of course, when the advisory position comes back, it is not binding, and it might very well be that the Security Council or the General Assembly would take a quite different view. It does not have to accept an advisory opinion of the International Court of Justice. The effect would be to throw the matter back into the political realm.

If the decision is taken that the United States ought to continue to have the right to use irritant gases and chemical herbicides, it seems to me that the only clear way to provide legal protection for the United States is to enter a reservation on this score, a reservation which would be communicated to the depositary and transmitted by the depositary to the various parties to the treaty.

I think the danger of objections to the reservation—objections which would have the effect of precluding treaty regulations between the objecting state and the United States—has been overestimated. There have been many reservations made to the Geneva protocol in the past, and to my knowledge there has never been an objection to any one of those.

It is possible that the same result might be achieved through an "understanding" with respect to chemical herbicides, as the case is somewhat closer there; but this would be a communicated understanding, and it would be open to states to determine whether they wished to treat this as a reservation or not. They could object to it. If they did object to it, this would preclude treaty relations between the objecting state and the United States.

IMPLICATIONS OF U.S. POSITION ON TEAR GAS

Finally, there are two collateral problems which have arisen, and I will say just a word or so if I may, Mr. Chairman, about these two before concluding these remarks.

One question which has been raised is whether, if the United States did undertake not to use tear gas, the protocol would preclude the employment of tear gas against rioting prisoners of war or civilians in an occupied area.

There is indeed a question about whether the use of tear gas for riot control purposes under these circumstances would be a use "in war" within the meaning of the protocol. At one time I expressed myself as thinking that this would be a prohibited use of tear gas. After further reflection, I have become more doubtful. I can see that if tear gas is used within a PW compound in order to maintain order, that is one thing if the prisoners were to attempt to escape and to resume hostilities, that would be another thing. In the latter case there might be a basis for saying this to employ tear gas against such prisoners would be

a use in war. I doubt, however, that tear gas would be used under these circumstances.

The other collateral question which has often been raised, I gather, is whether chemical herbicides could be used to clear perimeters about fixed or semipermanent installations. Again the case is a close one, but I suppose that a distinction could be made between the use of chemical herbicides against territory under enemy control, where it would be a use "in war" within the contemplation of the protocol, and a use of chemical herbicides in areas which are under the control of U.S. forces, which might not be considered to be a use in war. Such use might be distinguishable on the basis that it had not taken place in combat. I thus do not think that the undertaking of the general obligation not to use these two instruments would necessarily stand in the way of these two collateral employments in areas which are subject to the control of the United States.

VITAL FOR UNITED STATES TO BE PARTY TO PROTOCOL

It is important that these matters should be sorted out, and vitally important that the United States should a last become a party to the Geneva protocol of 1925. I am reminded of the observation, which I think has some bearing here, that there is only one reason for doing something and that all the others are reasons for doing nothing.

Thank you very much, Mr. Chairman.

Mr. ZABLOCKI. Thank you, Professor Baxter.

I presume you would like to have your prepared statement inserted in the record.

Mr. BAXTER. I would, sir, and I should have alluded to that fact in my remarks.

Mr. ZABLOCKI. Without objection, the gentleman's statement will be made part of the record at this point.

[Mr. Baxter's prepared statement follows:]

STATEMENT OF PROFESSOR R. R. BAXTER, HARVARD UNIVERSITY

The question that has bedeviled the ratification by the United States of the Geneva Protocol of 1925 for the Prohibition of the Use in War of Asphyxiating, Poisonous or Other Gases, and of Bacteriological Methods of Warfare[1] is whether the prohibition of the Protocol extends to irritant chemicals (often referred to in United States terminology as "riot control agents") and chemical herbicides.

The relevant language of the Protocol is:

> Whereas the use in war of asphyxiating, poisonous or other gases, and of of all analogous liquids, materials or devices, has been justly condemned by the general opinion of the civilised world; * * *
>
> (The High Contracting Parties, so far as they are not already Parties to Treaties prohibiting such use, accept this prohibition, agree to extend this prohibition to the use of bacteriological methods of warfare and agree to be bound as between themselves according to the terms of this declaration.

The position taken by the Executive Branch with respect to this question is reflected in the letter of Secretary of State Rogers to President Nixon of August 11, 1970, in which he stated that: "It is the United States understanding of the Protocol that it does not prohibit the use in war of riot-control agents and chemical herbicides."[2]

The quoted letter was attached to a message from the President to the Senate of the United States transmitting the Geneva Protocol with a view to receiving

[1] Done at Geneva, June 17, 1925, 94 L.T.N.S. 65.
[2] 63 Dep't State Bull. 273, 274 (1970).

the advice and consent of the Senate to its ratification.[3] The United States understandings with respect to "riot control agents" and chemical herbicides were thus communicated to the Senate but would not, in the contemplation of the Executive Branch, have been transmitted to the depositary of the Geneva Protocol as reservations or as understandings. On April 15, 1971, Senator Fulbright wrote to the President that he had "considerable doubt that the Protocol could now receive the advice and consent of the Senate on the terms laid down by the Secretary of State, i.e. that you might not ratify the Protocol if the proposed understandings are modified by action of the Senate." The Committee therefore requested that "the interpretation of the Protocol be reexamined." [4] And so the matter lies. The Executive Branch has not responded on the merits of the question.

The legal questions thus posed in connection with the ratification by the United States of the Geneva Protocol are:

(1) Does the Protocol, according to canons of interpretation accepted in international law, prohibit the use of irritant chemicals and chemical herbicides?

(2) If the Geneva Protocol does prohibit the use of irritant chemicals and chemical herbicides or there is an objective basis for saying that the Protocol is unclear on these points, and if the United States desired to continue its use of such agents, in what way could the interests of the United States best be protected? These two questions will be taken up in turn.[5]

THE INTERPRETATION OF THE GENEVA PROTOCOL

The best source of enlightenment on the permissible modes of interpretation of treaties in the Vienna Convention on the Law of Treaties of 1969,[6] which has been very widely relied upon as a guide to conduct, even by non-parties such as the United States. Article 31 of the Convention provides that—

> 1. A treaty shall be interpreted in good faith in accordance with the ordinary meaning to be given to the terms of the treaty in their context and in the light of its object and purpose.

There may be taken into account together with the context, according to paragraph 3—

> (b) any subsequent practice in the application of the treaty which establishes the agreement of the parties regarding its interpretation.

Only if the meaning produced by these rules of interpretation leaves the meaning "ambiquous or obscure" or leads to a result which is "manifestly absurd or unreasonable" may recourse be had, as a "supplementary" means of interpretation, to the preparatory work and circumstances of conclusion of the treaty.

It will be noted that the "subsequent practice" reflecting agreement on its interpretation is that of the "parties." The United States is not a party to the Protocol, and its views on the interpretation of the Protocol enunciated subsequent to 1925 consequently carry no weight in establishing the meaning of the treaty.

A. Irritant Chemicals

According to the first method of interpretation to be employed, the "ordinary meaning" of the prohibition in the Protocol of the use of "asphyxiating" and "poisonous" gases and "all analogous liquids, materials or devices" would be that the Protocol speaks in sweeping and all-embracing language of all gases—including irritant chemicals, such as tear gases. The difficulty is that the French text speaks of "gaz asphyxiantes, toxiques ou *similaires*." This has sometimes led authorities to assert that the Protocol applies only to chemical agents having harmful consequences similar to those of asphyxiating or poisonous gases.[7]

That this last was not the correct interpretation of the Protocol is indicated by the subsequent practice of the parties. In 1930, in the course of drafting a draft disarmament convention in the League of Nations Preparatory Commission for the Disarmament Conference, the question was raised whether a text proposed

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[3] Aug. 19, 1970, 63 Dep't State Bull. 273 (1970).

[4] 117 Cong. Rec. 18694 (1971).

[5] This statement draws heavily upon R. R. Baxter and T. Buergenthal, Legal Aspects of the Geneva Protocol of 1925, 64 Am. J. Int'l L. 853 (1970), reprinted in somewhat modified form in Carnegie Endowment for International Peace, The Control of Chemical and Biological Weapons 1 (1971). See also among the extensive literature on this subject A. Van W. and A. J. Thomas, Legal Limits on the Use of Chemical and Biological Weapons (1970); G. Bunn, Banning Poisonous Gas and Germ Warfare: Should the United States Agree? [1969] Wisc. L. Rev. 375; J. N. Moore, Ratification of the Geneva Protocol on Gas and Bacteriological Warfare: A Legal and Political Analysis, 58 Va. L. Rev. 419 (1972).

[6] Opened for signature at Vienna, May 23, 1969, U.N. Doc. A. CONF.39/27 (1969).

[7] See G. Bunn, op. cit. *supra* note 5 at 396–397.

for insertion in the convention relating to "use in war of asphyxiating, poisonous or similar gases" was designed to be more restrictive than the Geneva Protocol. The British Delegation took the view that "the use in war of 'other' gases, including lachrymatory gases, was prohibited" under the English text of the Geneva Protocol.[8] The French Delegation responded that it considered that "the use of lachrymatory gases is covered by the prohibition arising out of the Geneva Protocol" and that the existing texts were identical in their purport.[9] France and Great Britain and sixteen other states members of the Preparatory Commission were by this time parties to the Geneva Protocol.[10] Ten of them associated themselves with the French and British interpretation, while the remaining six members did not respond to the British invitation for an expression of opinion.

The United States representative expressed no view on the scope of the Geneva Protocol but was of the opinion that there would be hesitation on the part of many governments to bind themselves not to use in war agencies which they used for police purposes against their own nationals.[11] He proposed that no decision on the scope of the prohibition on chemical warfare be taken in the Preparatory Commission and that the decision should be left to the Disarmament Commission.[12] That proposal was accepted.[13] The draft convention ultimately adopted by the Conference stipulated that the prohibition of the use of chemical weapons applied "to the use, by any method whatsoever, for the purpose of injuring an adversary, of any natural or synthetic substance harmful to the human or animal organism, whether solid, liquid or gaseous, such as toxic, asphyxiating, lachrymatory, irritant or vesicant substances." [14] The United States found this provision acceptable.[15] The draft convention never entered into force, however.

The understanding of France and Great Britain was thus placed on record, and other participants in the Preparatory Commission and the Disarmament Conference, put on notice, either associated themselves with the broad construction put on the Protocol or a similarly broad prohibition in the proposed disarmament convention, or raised no objection to a general prohibition of gases which included irritant gases.

Neither before nor after 1930 has any state ever entered a reservation as to irritant gases, even though there have been a large number of reservations to the Protocol directed to other aspects of the instrument.

Only one state, Australia, which is a party to the Protocol has associated itself with the assertion by the United States in the General Assembly of the United Nations that the prohibition of the Geneva Protocol does not extend to irritant chemicals or anti-plant chemicals.[16] The United Kingdom has taken the ambiguous position that while "tear gases . . . are . . . prohibited under the Protocol, this prohibition does not extend to CS gas on the ground that CS is less toxic than the screening smokes excluded from the prohibitory scope of the Protocol.[17]

The most recent pronouncement on the scope of the Geneva Protocol—constituting "subsequent practice" establishing the agreement of the parties—is General Assembly Resolution 2603A (XXIV), December 16, 1969, which recited "that the Geneva Protocol embodies the generally recognized rules of international law prohibiting the use in international armed conflicts of all biological and chemical methods of warfare, regardless of any technical developments" and declared as contrary to the Geneva Protocol "Any chemical agents of warfare—chemical substances, whether gaseous, liquid or solid—which might be employed because of their direct toxic effects on man, animals or plants; . . ." The resolution was adopted by eighty votes to three (the United States, Australia, and

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[8] League of Nations, Documents of the Preparatory Commission for the Disarmament Conference (Series X: Minutes of the Sixth Session (Second Part) 311 (1931).

[9] Ibid.

[10] The remaining ten states, although not represented on the Preparatory Commission, were members of the League of Nations, under whose auspices the Commission was operating.

[11] League of Nations, Documents of the Preparatory Commission, cited *supra* note 8 at 312.

[12] Id. at 113. See also Report of the Preparatory Commission for the Disarmament Conference 45 (Dept. of State Conference Series, No. 7, 1931).

[13] Ibid.

[14] 2 League of Nations, Conference for the Reduction and Limitation of Armaments: Conference Documents 476, at 488 (1935).

[15] Minutes of the General Commission (Dec. 14, 1932–June 29, 1933), 2 League of Nations Conference for the Reduction and Limitation of Armaments (Series B) 569 (1933); Letter, Secretary of State Hull to Chairman of the American Delegation, March 23, 1933 [1933] 1 Foreign Rel. U.S. 72, at 75 (1950).

[16] 24 GAOR, 1st Comm., Doc. A/C.1/PV.1716, p. 82, at 87 (Prov.) (1969).

[17] 795 Parl. Deb., H.C. (5th ser.) 18 (1970) (written answers to questions).

Portugal), with thirty-six abstentions.[18] The large number of states voting for the resolution, including many parties to the Geneva Protocol itself, lend very substantial weight to the proposition that the Protocol forbids the use of irritant chemicals.

If one drops back to the third and supplemental method of interpretation, one is entitled to look to the preparatory work and circumstances of the conclusion of the treaty. The words of the Geneva Protocol can be traced back to the Treaty of Versailles, which prohibited "the use of asphyxiating, poisonous or gases and all analogous liquids, materials of devices" in Germany.[19] The French text again used the adjective "similaires." The same language found its way into the Treaty on the Use of Submarines and Noxious Gases in Warfare, signed in Washington in 1922 by France, Great Britain, Italy, Japan, and the United States.[20] The treaty never entered into force, but it was ratified by the United States. The proposal to include in the Treaty of Washington a provision on chemical warfare came from the United States Delegation. The Advisory Committee of the United States Delegation had proposed that "chemical warfare, including the use of gases, whether toxic or nontoxic, should be prohibited by international agreement." This and like statements relating to tear gas were called to the attention of the Committee on Limitation of Armaments by Secretary of State Hughes.[21] In view of this reliance on reports supporting a complete outlawing of chemical warfare and of failure of any state to raise a question about irritant chemicals, the record is quite clear that a comprehensive prohibition, extending to irritant gases as to other forms of chemical warfare, was intended.

The provisions of Article 5 of the Treaty of Washington with respect to chemical warfare became the basis for the Geneva Protocol of 1925. There was no discussion at the Geneva Conference on the scope of the Protocol. In the discussion in the Senate when it debated the desirability of ratification, the use of tear gas by police was referred to. The floor manager of the treaty denied that the Protocol would prohibit such use of tear gas and appeared to be of the belief that the use of tear gas in war was prohibited by the Protocol.[22]

Thus whether one looks to the ordinary meaning of the Protocol (at least in its English text), the subsequent practice of the parties (excluding the pronouncements of non-parties such as the United States), or to the drafting history of the Protocol, there is strong evidence that the Protocol should be interpreted to prohibit the use of irritant chemicals in war.

B. Chemical herbicides.

The evidence that chemical herbicides fall within the prohibition of the Geneva Protocol is much less clear than in the case of irritant chemicals.

It has already been demonstrated that the Protocol should be interpreted in a broad sense, according to the three methods of interpretation set forth in the Vienna Convention on the Law of Treaties. There is no evidence in the negotiating history of the Protocol to indicate that its draftsmen intended to exclude from its reach the use in war of plant-destroying chemical agents. On the contrary, it was made plain that at least the prohibition on biological warfare was intended to be comprehensive. The records of the Geneva Conference of 1925 indicate that the sponsor of this prohibition, the Polish representative, repeatedly warned that "great masses of men, animals and plants would be exterminated" unless biological warfare were outlawed, and this view was supported by France.[23] However, France in 1930 seemed to interpret the Protocol as forbidding the employment of chemical agents "with a view to toxic action on the human organism."[24] This is the only solid evidence from past history to support the doubts that some parties to the Protocol have recently expressed on its applicability to anti-plant chemicals.[25]

As in the case of irritant gases, the strongest indication of the subsequent practice of states is furnished by General Assembly Resolution 2603 A (XXIV),

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[18] U.N. Doc. A/PV.1836, at 16 (Prov.) (1969).

[19] Treaty of Peace between the Principal Allied and Associated Powers and Germany, signed at Versailles, June 28, 1919, art. 171 [1919] Great Britain, Treaty Series, No. 4.

[20] U.S. Senate, Conference on the Limitation of Armaments 888 (1922).

[21] Id. at 384–394.

[22] 68 Cong. Rec. 141–154, 226–229, and 363–368 (1927).

[23] League of Nations, Proceedings of the Conference for the Supervision of the International Trade in Arms and Ammunition and in Implements of War 340–341 (1925).

[24] See note 8 *supra*.

[25] See, e.g., the statements of the French and Dutch delegations in the General Assembly in 1966. 21 U.N. GAOR, 1st Comm. 204–205 (1966).

adopted on December 16, 1969. That resolution declared that the General Protocol forbids the use in international armed conflicts of:

> Any chemical agents of warfare—chemical substances, whether gaseous, liquid or solid—which might be employed because of their direct toxic effects on man, animals, or plants.

The vote on this resolution, as noted above,[26] was eighty to three (the United States, Australia, and Portugal) with thirty-six abstentions. However, politically dictated the vote may have been, it is still the best indication of the contemporary understanding of the Protocol, constituting, at least as to the parties voting in the affirmative, an agreement on its interpretation.

POSSIBLE COURSES OF ACTION IN THE ABSENCE OF FULL AGREEMENT ON THE SCOPE OF THE PROTOCOL

The handling of these problems of interpretation which was proposed by the Executive Branch was to refrain from any reservation or understanding which would form part of the instrument of ratification and merely to put on record in a communication to the Senate that the Protocol is regarded by the United States as not prohibiting the use of "riot-control agents" and chemical herbicides.[27] Presumably the route of a reservation or understanding communicated to the depositary was not adopted because of fears that there might be objections from other parties, which, as will be seen, would have the effect of precluding treaty relations between the objecting states and the United States.

If the desire of the Executive Branch is to maintain the right to use "riot control agents" and chemical herbicides, then the solution proposed creates the illusion of security without the reality of any legally effective reservation by the United States of the right to use these agents. The interpretation of the United States would be on record, but it would remain only one state's interpretation, not calling for any challenge or acquiescence by other parties. It is "one man's opinion" communicated to another branch of Government and not to the community of parties to the Protocol. As such, it is a bureaucrat's solution, reflecting in all likelihood a paper compromise worked out in the Executive Branch.

If the root of the problem is the authentic interpretation of the Protocol, the various methods of resolving this question all have their defects. A number of the options that are open have been described elsewhere[28] and need not be discussed here at any length. Any attempt to convene a new conference to draft a supplementary agreement which would interpret the Protocol as covering the two types of chemical agents would be regarded as otiose by the great majority of parties. The same would be true of any attempt "to poll" other parties, either implicitly or explicitly. There would be a grave danger that a variety of views might be elicited, which would then be subject to differing interpretations. If application of the Protocol to the two disputed categories of agents were to be conditioned on reciprocity, the establishment of that reciprocity and of its precise scope would likewise lead to a complex pattern of ambiguous bilateral relations between the United States and other nations. The probable outcome of these proposed courses of action would be an enhanced uncertainty about the scope of the Protocol and about its binding force with respect to individual states.

The proposal that has been made to seek an advisory opinion of the International Court of Justice would of course be contingent upon a request by the Security Council or the General Assembly for such an advisory opinion.[29] But more than this, the resulting advisory opinion would be subject to approval or disapproval by the organ of the United Nations requesting it, and there is no certainty that the same interpretation would be put on the Protocol by the General Assembly or Security Council as by the International Court of Justice. If the fear is one of a politically dictated interpretation of the Protocol, that difficulty cannot be overcome through an advisory opinion which is subject to review in an essentially political organ.

It is not within the competence of the writer to determine whether the United States should or should not reserve the right to use "riot control agents" and

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[26] See note 18 *supra*.

[27] Letter of Secretary of State Rogers to the President, Aug. 11, 1970, 63 Dep't State Bull. 273 (1970).

[28] See R. R. Baxter and T. Buergenthal, Legal Aspects of the Geneva Protocol of 1925, 64 Am. J. Int'l L. 853 at 873–879 (1970); and J. N. Moore, Ratification of the Geneva Protocol on Gas and Bacteriological Warfare: A Legal and Political Analysis, 58 Va. L. Rev. 419 at 478–506 (1972).

[29] U.N. Charter, art. 96, para. 1.

chemical herbicides. But if the decision is taken that the United States must continue to have the legal right to use such agents, then the only sure protection for the United States can come through formal reservations to the Protocol—or perhaps, in the case of chemical herbicides, by way of an "understanding."

Under the Vienna Convention of 1969 on the Law of Treaties, a state may make a reservation to a multilateral treaty (with certain exceptions not here relevant).[30] If the United States were to reserve as to these two agents, other parties to the Protocol would be entitled to accept or reject the reservation. If a party to the Protocol were to remain silent and raise no objection to the reservation, then it would be regarded as having accepted the modification proposed by the reservation, just as if that party had expressly accepted the reservation. Other parties to the Protocol would have the privilege of rejecting the reservation, in which case there would be no treaty relations under the Protocol between the United States and the objecting state.[31] There have been a substantial number of reservations made to other aspects of the Protocol, and there does not appear to have been any objection to any of them—that is to say, the reservations have always been accepted. The danger that states which might be adversaries of the United States in war would object to a United States reservation on these two agents must be reckoned with. However, this is a risk which must be faced when an interpretation is advanced which does not accord with that entertained by other states. It would ultimately be better for the United States to be bound by the Protocol (less "riot control agents" and chemical herbicides) with respect to a large number of countries than not to be a party to the Protocol at all.

A reservation would point in the direction of the United States' conceding that the Protocol does apply to irritant gases and to chemical herbicides. That concession woud have to be made in order to secure the protection of the reservation.

An "understanding" or "statement" communicated by the United States to other parties to the Geneva Protocol might be a sound alternative in the case of chemical herbicides. If another party chose to treat such a declaration as a reservation, it could accept it or reject it. If it chose not to treat it as a reservation, the question of the application of the Protocol to chemical herbicides would remain open. The use of an "understanding" or "statement" differs from the present position under Secretary of State Rogers' letter of August 11, 1970 in that the interpretation by the United States would be communicated to the depositary state, France, and by France communicated to the other parties to the Protocol.

The use of an "understanding" or "statement" is suggested in ths case but not in that of irritant gases because of the greater uncertainty surrounding the application of the Protocol to chemical herbicides. The United States would be in a position to say that if other states had not objected to the United States understanding, they had acquiesced in it.

Two collateral problems about the use of "riot control agents" and chemical herbicides deserve mention.

The first is the question of whether, if the Protocol does apply to irritant gases, the use of tear gas against prisoners of war in a camp would constitute a prohibited use in "war." The writer has previously answered this question in the affirmative,[32] but further reflection has led to renewed doubts. If prisoners of war were attempting to break out of a camp and were employing violence to do so, then they might be thought to be once more engaging in "war" and the use of tear gas against them would be unlawful. However, it seems highly unlikely that tear gas would be used as a weapon against mass escape or attempted escape. The employment of tear gas simply to maintain order amongst rioting prisoners might be distinguished on the ground that the rioters had not again resorted to war. This same view might be taken with respect to the use of irritant gases against rioting civilians in occupied areas. Use under such circumstances might be regarded as a routine police measure.

The second question relates to the use of chemical herbicides to clear a perimeter around a fixed installation or a semi-permanent installation. If chemical herbicides are forbidden by the Protocol, the question is a close one, but a case could be made for such use on the ground that herbicides would not be used against enemy-held areas but to clear ground under the control of a party to the conflict. That non-combat use of chemical herbicides might be distin-

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[30] Art. 19, U.N. Doc. A/CONF.39/27 (1969).

[31] Arts. 20 and 21.

[32] R. R. Baxter and T. Buergenthal, Legal Aspects of the Geneva Protocol of 1925, 64 Am. J. Int'l L. 853 at 869 (1970).

guished from their use in combat or "war"—just as a distinction might be made between appropriation or destruction of structures in an area subject to the control of a belligerent and the bombardment and destruction of structures in territory under the control of its adversary. The case is a close one, but a logical basis can be adduced for this limited use of herbicides. The need for this limited employment thus need not stand in the way of a general acceptance of the proposition that the Geneva Protocol covers chemical herbicides.

Mr. ZABLOCKI. Dr. Price.

STATEMENT OF DR. CHARLES C. PRICE, FORMER PRESIDENT, AMERICAN CHEMICAL SOCIETY

Mr. PRICE. Thank you, Mr. Chairman.

Mr. Chairman, members of the committee, my name is Charles Price and I am a past president of the American Chemical Society and I appear before you with the authorization of the Society's board of directors to present this statement. Accompanying me today are Dr. Richard L. Kenyon, director of the Society's public affairs and communications division, and Dr. Stephen T. Quigley of the Society's Department of Chemistry and Public Affairs.

To interject, I had considerable experience with chemical warfare agents in World War II. I led a development at the University of Illinois on the behavioral effects, decontamination and purification of water containing all known chemical agents, including the G agents, or nerve gases.

For about 10 years after World War II, I served on the American Chemical Society advisory committee to the U.S. Chemical Corps, and was its chairman for 3 years.

AMERICAN CHEMICAL SOCIETY POSITION ON PROTOCOL

Mr. Chairman, we have two letters announcing the recent official actions of the American Chemical Society regarding ratification of the 1925 Geneva protocol that we would like to submit for the record.

Mr. ZABLOCKI. Without objection, so ordered.

[The letters refered to follow:]

AMERICAN CHEMICAL SOCIETY,
Washington, D.C., September 15, 1970.

Hon. J. WILLIAM FULBRIGHT,
Chairman, Foreign Relations Committee,
U.S. Senate, Washington, D.C.

DEAR SENATOR FULBRIGHT: The American Chemical Society, the world's largest membership organization devoted to a single science, was originally incorporated in New York City in 1876 and re-incorporated by an Act of Congress in 1937. The Society was chartered by the Congress of the United States under Public Law 358, 75th Congress, Chapter 762, 1st Session, and signed into law by Franklin D. Roosevelt, August 25, 1937. The Society's interest in the ever increasingly complex problems confronting our nation is self-evident from a reading of the objects of the Society, as set forth in Section 2 of the Congressional Charter, which provides as follows:

> Section 2. That the objects of the incorporation shall be to encourage in the broadest and most liberal manner the advancement of chemistry in its branches; the promotion of research in chemical science and industry; the improvement of the qualifications and usefulness of chemists through high standards of professional ethics, education and attainment; the increase and diffusion of chemical knowledge; and by its meetings, professional contacts, reports, papers, discussions, and publications, to promote scientific interests and inquiry, thereby fostering public welfare and education, aid-

ing the development of our country's industries and adding to the material prosperity and happiness of our people.

The Society has noted with considerable interest that President Nixon has submitted the 1925 Geneva Protocol to the United States Senate for its advice and consent to ratification. The consequence of such action would be to commit the United States not to use poison gases and bacteriological weapons in warfare. The American Chemical Society believes that prompt ratification of this Protocol is in the best interest of the United States.

In 1925 the Society adopted a position in opposition to the Protocol. The 1925 Society position was based on considerations of both national safety and humanity. At that time it was widely believed that non-lethal but temporarily incapacitating chemicals could make warfare more humane than it had been. In the 45 years since that action, it has become apparent that the military importance of chemical-biological weapons has been considerably diminished. In addition, justifiable public concern about the destructive aspect of such weapons has increased. Consequently, the American Chemical Society, after serious study and discussion, has taken the following actions:

At its meeting on Sunday, September 13, 1970, the Board of the Directors of the American Chemical Society unanimously passed the following resolution:

Whereas the Board of Directors and Council of the American Chemical Society at its 160th national meeting in Chicago, September 13–18, 1970, thoroughly considered the Geneva Protocol relative to Chemical and Biological Warfare and the position of the President of the United States recently requesting Senate ratification of same; Now therefore be it

> *Resolved*, That the Board of Directors and Council of the American Chemical Society support the recent action of the President of the United States in submitting to the United States Senate for ratification the Geneva Protocol of 1925 prohibiting the use of asphyxiating, poisonous or other gases, and of bacteriological methods of warfare, and urge the United States Senate to ratify the Protocol; the Board of Directors and Council of the American Chemical Society note further that this resolution supersedes a contrary resolution on the Geneva Protocol which was adopted by the Council of the American Chemical Society on August 3, 1925.

Subsequently, the Council of the American Chemical Society, at its meeting on Tuesday, September 15, 1970, also passed the above resolution unanimously.

In ratifying the Geneva Protocol, the United States will be joining a community of nations which includes every major world power. With respect to biological weapons, it will be formalizing a no-use policy which has already been taken unilaterally by the President of the United States. Finally, by ratifying the Protocol, the United States will be taking another small but significant step toward control of the weapons of war, a goal which, in view of the increasing horrors of modern war, must be given a high priority by all nations.

We urge you to use your personal leadership to accomplish Senate ratification of the Protocol. The American Chemical Society is ready to assist your efforts in any way it can.

Sincerely yours,

BYRON RIEGEL, *President*.

AMERICAN CHEMICAL SOCIETY,
Washington, D.C., September 17, 1973.

Hon. J. WILLIAM FULBRIGHT,
Chairman, Committee on Foreign Relations,
U.S. Senate, Washington, D.C.

DEAR SENATOR FULBRIGHT: In a September 15, 1970 letter addressed to you from the 1970 President of the American Chemical Society, Dr. Byron Riegel, the actions of the Society's Board of Directors and Council with regard to ratification of the Geneva Protocol of 1925 were enumerated. The resolution that reversed the long-standing opposition of the American Chemical Society to ratification of the Geneva Protocol of 1925 passed the Board of Directors on September 13, 1970 and the Council on September 15, 1970. It reads as follows:

> Whereas the Board of Directors and the Council of the American Chemical Society at its 160th National Meeting in Chicago, September 13–18, 1970, thoroughly considered the Geneva Protocol relative to Chemical and Biological Warfare and the position of the President of the United States recently requesting Senate ratification of same: Now therefore be it

Resolved, That the Board of Directors and Council of the American Chemical Society support the recent action of the President of the United States in submitting to the United States Senate for ratification the Geneva Protocol of 1925 prohibiting the use of asphyxiating, poisonous or other gases, and of bacteriological methods of warfare, and urge the United States Senate to ratify the Protocol; the Board of Directors and Council of the American Chemical Society note further that this resolution supersedes a contrary resolution on the Geneva Protocol which was adopted by the Council of the American Chemical Society on August 3, 1925.

That resolution, of course, supports President Richard M. Nixon's submission of the Geneva Protocol of 1925 for the advice and consent of the Senate to ratification. Since the Geneva Protocol was transmitted with the report of the Secretary of State which set forth understandings and a reservation with respect to the Protocol, the ACS Joint Board-Council Committee on Chemistry and Public Affairs deliberated at several executive sessions earlier this year on whether the Society had gone far enough in that resolution. The renewed interest of the Committee on Chemistry and Public Affairs on behalf of the Society was prompted especially by President Richard M. Nixon's understanding that the Protocol does not prohibit the use in war of riot-controlled agents and chemical herbicides, or of weapons utilizing smoke, flame or napalm.

During its deliberations, the ACS Committee on Chemistry and Public Affairs reviewed your letter of April 15, 1971 to President Richard M. Nixon on behalf of the Senate Committee on Foreign Relations which followed hearings on the Protocol in March 1971 and requested that the President reconsider the Administration's interpretation that the Protocol does not prohibit the use of tear gas and herbicides in warfare. Attention eventually focused on endorsement of Senate Resolution 48, reintroduced by Senator Hubert H. Humphrey, as a means of both clarifying the Society's position with regard to the Protocol and encouraging a reinterpretation of the Administration's position. Thus, the Board of Directors of the American Chemical Society took the following action at its meeting on June 1, 1973:

Voted, with one dissent, on recommendation of the Committee on Chemistry and Public Affairs, that the American Chemical Society endorse Senate Resolution 48, a resolution to register the support of the United States Senate for approval without qualification the Geneva Protocol on the use of chemical and biological weapons in warfare, thus reaffirming the Society's support in 1970 of ratification of the Geneva Protocol, but without the reservations then expressed in the Administration's recommendation.

Subsequently, at its meeting on Tuesday, August 28, 1973, the Council of the American Chemical Society endorsed the June 1, 1973 action of the Board of Directors with regard to Senate Resolution 48.

I wish to express to you and the Senate Committee on Foreign Relations the interest of the American Chemical Society in any forthcoming hearings on Senate Resolution 48, which we understand are now pending before the Subcommittee on Arms Control, International Law and Organization. It is the Society's hope that there will be an opportunity at those hearings to present a detailed policy statement on ratification of the Geneva Protocol of 1925 in support of the passage of Senate Resolution 48.

I would like to add that the Society's interest in chemical and biological weaponry is not restricted to the Geneva Protocol of 1925. The ACS Committee on Chemistry and Public Affairs has begun initial planning jointly with the Scientists' Committee on Chemical and Biological Warfare for a symposium on the broad issues involving chemical and biological weaponry. The symposium will be a part of a continuing program of symposia and public affairs topics to be held at the Society's National Meetings, and is to be held at the 167th National Meeting in Los Angeles, California in the spring of 1974.

So that you might place the actions of the American Chemical Society in proper perspective, I should mention that it is a member organization, with no chemical or other companies as members, consisting of approximately 109,000 individual chemists and chemical engineers reflecting a broad spectrum of engagement in academic, governmental and industrial professional pursuits. About 70% of our members are employed by industry, about 20% by academic institutions, and 10% by government and nonprofit institutions. The American Chemical Society was founded in 1876 and chartered by an act of Congress in 1937 as a nonprofit, scientific and educational organization. Its Federal incor-

poration replaced a New York Charter which had been effective since November 9, 1877. Under its National Charter the Society is charged with the responsibility to work for the advancement, in the broadest and most liberal manner, of chemistry, "thereby fostering the public welfare and education, aiding the development of our country's industries, and adding to the material prosperity and happiness of our people." Also, the Charter imposes an obligation on the Society to provide assistance to the Government in matters of national concern related to its areas of competence. The ACS Committee on Chemistry and Public Affairs was established in 1965 as a joint "policy" committee of the Board of Directors and the Council to consider policy questions in public affairs areas and also to provide guidance on public issues to the "technical" committees of the Society.

Again, I wish to express to you the interest of the American Chemical Society in ratification of the Geneva Protocol without qualification and the Society's desire for the opportunity to present its views on the subject at any forthcoming hearings on Senate Resolution 48.

Sincerely yours,

ALAN C. NIXON, *President.*

Mr. PRICE. The society specifically wishes to acknowledge the efforts in 1969 of this subcommittee in seeking the resubmission of the 1925 Geneva protocol to the Senate for its advice and consent to ratification.[1] This has had a significant effect on the actions of the U.S. Government.

Mr. ZABLOCKI. Thank you.

Mr. PRICE. We appreciate being given this opportunity to comment on the resolutions before this subcommittee, which urge ratification by the United States of the Geneva protocol of 1925 and a review of U.S. chemical weapons policies. It is appropriate that we give this testimony since our national charter imposes obligations on the society to provide assistance to the Government in matters of national concern related to the society's areas of competence and also to work for the advancement, in the broadest and most liberal manner, of chemistry, "thereby fostering public welfare and education, aiding the development of our country's industries, and adding to the material prosperity and happiness of our people."

Founded in 1876, the American Chemical Society was chartered as a nonprofit, scientific and educational organization by an act of Congress which was signed into law on August 25, 1937. Current membership in the society is about 110,000 individual chemists and chemical engineers. The society has no corporate memberships. The membership reflects a broad spectrum of engagement in academic, governmental, and industrial professional pursuits. About 60 percent of our members are employed by industry, about 25 percent by academic institutions, and 15 percent by Government and nonprofit institutions.

GENEVA PROTOCOL

The American Chemical Society has had an abiding interest in chemical warfare policies and in recent years, primarily through its Joint Committee on Chemistry and Public Affairs of the Board of Directors and Council, has fostered an ongoing debate on the issues inherent in U.S. ratification of the Geneva protocol of 1925, prohibiting

[1] Hearings before the Subcommittee on National Security Policy and Scientific Developments of the House Committee on Foreign Affairs (91st Cong., 1st sess.) held Nov. 18, 20, Dec. 2, 9, 18, and 19, 1969. "Chemical-Biological Warfare: U.S. Policies and International Effects," U.S. Government Printing Office, Washington, D.C., 1970.

the use in war of asphyxiating, poisonous or other gases, and of bacteriological methods of warfare.

In fact, at the recent national meeting of the American Chemical Society I attended an interesting and well-attended 1-day public affairs symposium on "Chemical weapons and U.S. Public Policy." One of your colleagues, Congressman Owens, was one of the speakers at this symposium.

In the course of these deliberations, the Committee on Chemistry and Public Affairs has also consulted with scientific experts outside the membership of the society, to broaden the society's perspective on these issues. The society recognizes these issues as fundamental to the security of the Nation and of vital significance to the ability of our Nation to resolve both domestic and international problems that confront it. We believe that views presented here by the American Chemical Society represent a consensus of the chemical science community.

In September 1970, the Board of Directors and the Council of the American Chemical Society adopted a resolution in support of the ratification by the United States of the Geneva protocol of 1925.[2] Following this general resolution, the Board of Directors in June 1973, and the council in August 1973, registered their support [3] for ratification of the 1925 protocol without the understanding that excludes riot control agents and herbicides which was stipulated in the report of the Secretary of State accompanying President Nixon's statement of August 19, 1970, transmitting the 1925 protocol to the Senate. That understanding—the exclusion of riot control agents and chemical herbicides—was not explicitly dealt with in the position taken by the society in 1970.

EARLY ACS POSITION

These actions superseded a resolution adopted by the council of the ACS on August 3, 1925, which endorsed the use of chemical warfare agents. The reversal of the society's position is only partially due to the general evolution in the public view of the degree of "humaneness" of chemical warfare. More specifically, it has been the result of the consideration that the nature of warfare has changed drastically since World War I when use of chemical agents was prevalent. Then chemical warfare was restricted to a narrow battle zone by technological limitations and affected virtually only the combatants. It was in that context that the 1925 ACS resolution was drafted.

During and since World War II, the means of delivery of all munitions—conventional high explosive, chemical, and nuclear—have undergone extraordinary evolution. The battlefield has expanded greatly and now can encompass entire countries. In the event that chemical warfare agents are used again they could exact a great toll among civilians as well as the military. In fact, since substantial measures of protection and advanced training are usually available to the military, the more likely victims of chemical warfare will be civilians. Chemical warfare agents have become weapons of indiscriminate mass destruction and, in our view, every step toward their nonuse and eventual elimination should be encouraged.

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[2] ACS letter to Senator Fulbright, dated Sept. 15, 1970, see p. 115.
[3] ACS letter to Senator Fulbright, dated Sept. 17, 1973, see p. 116.

As chemists, we know that there are many different compounds that could be used as chemical warfare agents. They range from lethal to incapacitating, exhibit various degrees of persistence, and can be directed at man, animals, or plants. However, we believe it prudent in formulating U.S. chemical weapons policies to give first consideration to those agents that could threaten the population of the United States most seriously.

MASS DESTRUCTION CAPABILITY OF LETHAL AGENTS

Modern lethal chemical agents possess great mass destructive capability at relatively low cost if used against persons lacking masks, suits, and other protective equipment. There is no effective and practical protection for civilians in a society like our own, particularly in the case of terrorist or surprise attack. Lethal chemical weapons, therefore, pose a serious potential threat to civilians in war or peace and, should that threat materialize, effective protection cannot reasonably be provided.

From this it follows that it is strongly in the interest of the United States to discourage the proliferation of chemical warfare capability and to strengthen the psychological and political restraints against using chemical weapons. Such constraints can be accomplished by refraining from initiating the use of chemical weapons ourselves and by our building, through treaties and other means, an international consensus against their use and, hopefully, also against their manufacture and stockpiling.

A crucial issue blocking prompt Senate approval of ratification of the 1925 Geneva protocol, as has been mentioned by Professor Baxter, is the dispute over whether the use of riot control agents and herbicides is to be banned.[4] While it has been generally agreed by most nations that their use should be banned,[5] the U.S. administration has indicated its intention to consider that use of these weapons in warfare is not covered by the protocol.[6]

EXCLUSIONS UNDERMINE GENEVA PROTOCOL

It is our view that the value and significance of the Geneva protocol would be seriously undermined by such an exclusion. As chemists, we assert that there is indeed a continuous gradation in the toxicity of chemical agents and, therefore, in the incidence of lethality. Consequently, it is difficult to draw sharp distinctions between lethal, incapacitating, and riot control agents. Such distinctions are even more difficult to make by nontechnically trained individuals, particularly in view of the wide variation in sensitivity to specific agents among individuals. Any exclusion of one or more types of chemical agents would thus tend to confuse and undermine the intent of the Geneva protocol to ban the use of such weapons. The American Chemical Society concludes that an international ban on chemical weapons, to

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[4] Letter to President Richard M. Nixon from Senator J. William Fulbright on behalf of the Senate Committee on Foreign Relations requesting a reevaluation of the administration's interpretation that the Geneva Protocol does not cover the use of tear gas and herbicides in warfare, Apr. 15, 1971.

[5] U.N. General Assembly vote—General Assembly Resolution 2603A—which records 80 nations (to 3 nations opposed and 36 abstaining) as considering that the use in war of any chemical warfare agent is contrary to the 1925 Protocol, Dec. 16, 1969.

[6] Report of Secretary of State William P. Rogers of Aug. 11, 1970, submitted with the statement of President Richard M. Nixon transmitting the 1925 Geneva Protocol to the Senate for its advice and consent to ratification, Aug. 19, 1970.

be effective, needs to be simple and clear. It must include all chemical weapons.

Any evaluation of the use of chemical weapons in general, and riot control agents in particular, would need to take account of the sophistication of the potential adversary in countering their effectiveness by defensive measures. This suggests that their effectiveness would be minimal against well-prepared, sophisticated military personnel as compared to civilian populations, especially those of less-developed nations. Thus, it seems that these military weapons are of least value against the Nation's major potential adversaries.

This point is especially important for riot control agents and herbicides which are even less effective [7] than lethal chemical and biological agents which the United States agrees should be banned. The Geneva protocol banning military use in war, of course, would not prevent such use when required by civilian police forces in domestic situations.

U.S. POLICY OF NO-FIRST-USE

The United States has long had a clearly defined and oft-repeated policy of no-first-use of lethal and incapacitating chemical weapons. This policy limits the military purposes for which existing U.S. stockpiles of these weapons might be used. They do serve to provide a like-with-like retaliatory capability, and to afford whatever form of deterrence is inherent in such a capability. Since the potential utility of the stockpiles—the rationale for their existence—has been limited to this extent, it seems important to consider carefully whether the advantages of retaining the weapons do, in fact, outweigh the advantages of discarding them. The American Chemical Society believes that an agreement on chemical disarmament could contribute in an important way to current diplomatic endeavors toward reducing mistrust and tension between nations and toward promoting an atmosphere of détente.

Review of U.S. chemical warfare policies

Provisions for a comprehensive review of current U.S. chemical warfare policies are contained in the resolutions before this subcommittee. In line with the foregoing remarks, such a review might profitably attempt to evaluate, in terms of their particular contributions to U.S. national security, the competing merits of a policy of chemical deterrence as opposed to a policy of chemical disarmament. We note that it is already the stated policy of the United States to promote international chemical disarmament negotiations.[8] [9] [10] [11]

Matters to be resolved in such a review of chemical warfare policies should, in our view, include the following:

1. How significant a threat to U.S. national security does possession of chemical weapons by potential adversaries in fact represent, taking

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[7] Vols. I and II of "Herbicides and Military Operations," Army Corps of Engineers Strategic Studies Group, February 1972.

[8] Report of Secretary of State William P. Rogers of Aug. 11, 1970, submitted with the statement of President Richard M. Nixon transmitting the 1925 Geneva Protocol to the Senate for its advice and consent to ratification, Aug. 19, 1970.

[9] Draf Convention on the Prohibition of the Development, Production, and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on Their Destruction, art. IX in particular, signed Apr. 10, 1972, at Washington, London, and Moscow.

[10] Report of President Richard M. Nixon to the Congress, "U.S. Foreign Policy for the 1970's—Shaping a Durable Peace," May 3, 1973.

[11] Nixon-Brezhnev communiqué, June 25, 1973.

into account the efficiency of currently deployed antigas protective equipment and the overall array of military capabilities possessed by the United States?

2. If the threat is significant, to what extent is it mitigated by possession of a like-with-like retaliatory capability?

3. International chemical disarmament would, if actually carried out, remove the threat altogether; but how great would the residual threat be if such disarmament were not adequately verified?

4. In order to determine what would constitute "adequate" verification, is it possible to specify a degree of verification—that is, a probability of detecting abrogation—which would represent the same or a greater degree of security than that provided by the existing posture of like-with-like deterrence?

5. If so, what would be the disadvantage, in terms of national security, of replacing the existing chemical weapons policy by one of chemical disarmament?

INCREASED U.S. COMMITMENT NEEDED

These matters are not easy to resolve, and it appears to be clear from the progress currently made at the conference of the U.N. Committee on Disarmament that much time and study will be needed to do so. An increased commitment by the United States, we believe, could be instrumental in reducing the time required to resolve these questions.

A relevant issue in the promotion of international restraints on chemical weapons is the impending U.S. decision on binary nerve gas munitions. The American Chemical Society has weighed the arguments for and against and concludes that the best interests of the United States would be served by at least postponing such production. The argument in favor of proceeding with production is that binary munitions, after they have been adequately field-tested and manufactured, would be safer to store and handle than our present nerve gas weapons. This argument is a valid one, but the disadvantages must also be weighed against this advantage.

The arguments against manufacture of binary nerve gas weapons are these:

1. Such weapons will necessarily be extensively field-tested and such tests can be attended by very real hazards, as evidenced by the extensive loss of sheep in 1968 shortly after open-air testing of a lethal nerve agent.[12]

2. It is unofficially estimated that the cost of replacing two of the present U.S. nerve gas munitions with binary weapons will be about $250 million. The cost of replacing all of them would be considerably higher, and might exceed $1 billion.[13]

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[12] Letter of Hon. Thaddeus R. Beal, Under Secretary of the Army, to Hon. Calvin Rampton, Governor of Utah, addressing the issue of Army responsibility for the accident in March 1968 which led to the death of sheep near Dugway Proving Grounds in Utah, dated July 25, 1969. The Army's investigation of the incident, Under Secretary Beal states, revealed that the open-air test of nerve agent VX "contributed to the sheep's death," although the investigation "has never identified the precise causal chain."

[13] J. P. Perry Robinson, Research Fellow of the Science Policy Research Unit and of the Institute for the Study of International Organisation, University of Sussex, United Kingdom; "Binary Nerve-Gas Weapons," paper prepared for the American Chemical Society Symposium on "Chemical Weapons and U.S. Public Policy," Los Angeles, Calif., Apr. 1, 1974; and for the Pugwash Chemical Warfare Workshop, Helsinki, Finland, Apr. 16–18, 1974.

QUESTION NEED FOR BINARY PROCUREMENT

This may not be too high a price to pay for increased safety, especially for civilians living near the storage areas. However, since to date there have been no civilian casualties from the manufacture or transfer of nerve gases, we question the need for undertaking such an extensive procurement, testing, and replacement program and suggest that this same sum could produce greater benefits if devoted to alternative projects.

Furthermore, we should like to call attention to an additional argument, even though it is not entirely technical in nature. If, in the open society of the United States, we implement a large-scale program to upgrade the present nerve gas stockpile, these efforts will be widely known and discussed. This action of the United States could easily serve as stimulus and moral sanction for other nations to do likewise, and so tend to encourage proliferation of these weapons. Of course, we should point out that advanced nations will have no difficulty in making them, in any event, and some probably have done so.

A greater concern of the American Chemical Society is that the more such know-how is developed, especially in an open society like that of the United States, the more readily the technology can be disseminated to less developed nations. Furthermore, the simplicity and accessibility of the components of the binary nerve agents make this weapon potentially available to terrorists.

NO URGENT MILITARY NEED FOR BINARY

None of the foregoing relates to giving up gas weapons altogether, or even to renouncing the possibility of producing binary nerve gases at some time in the future, but does suggest that no urgent military need presses the United States to take a step that is expensive, potentially hazardous in execution, potentially disadvantageous in encouraging proliferation and, in our view, may inhibit effective action on chemical disarmament.

In conclusion, the American Chemical Society offers its full support for immediate ratification of the 1925 Geneva protocol with the understanding that it covers all chemical weapons. The time has arrived for the protocol to be established as a large step toward a full and binding international restriction on the use of chemical and biological weapons in warfare.

Thank you, sir.

Mr. ZABLOCKI. Thank you, gentlemen, for your excellent thought provoking statements.

It is my understanding that our colleague, Mr. du Pont, has a meeting to attend, so if you want to present your questions at this time you may.

Mr. DU PONT. All right, gentlemen, I will.

Mr. ZABLOCKI. I am yielding to you, sir.

Mr. DU PONT. Thank you.

First a word of welcome to Professor Baxter, who some 15 years ago taught me in criminal law at the Harvard Law School, and I was such a poor student that I ended up in Congress. It is a pleasure to welcome you here, and I hope I can do better this morning than I did back in those dim days.

Professor Baxter, as I read your testimony there is a little reservation on your part, a little hesitancy to recommend the policy to us, but putting that aside for the moment, if we feel we have to retain the right to use tear gas and riot control agents it is your recommendation, as I understand it, that we ratify the protocol with a reservation?

Mr. BAXTER. That is right, Mr. du Pont.

Mr. DU PONT. That is the least risky course.

LEAST RISKY COURSE

Mr. BAXTER. That is the least risky course, less risky than the proposed course of action that there simply be an understanding on the record in the form of a communication between the President and the Senate.

Mr. DU PONT. Do you see any serious international repercussions to ratifying with the reservations?

Mr. BAXTER. No. It seems to me that if the United States had in 1970 pushed the ratification through with reservations, no one would really have taken very much notice of them. Perhaps the danger is marginally enhanced now that so much attention has been directed to this issue in the United States and others have become aware of it, but I am still encouraged by the thought that there has never, to my knowledge, been an objection raised to a reservation made by any state in connection with ratification of the Geneva protocol. I suppose that the general attitude would be that it would be well to have the United States on board as to 90 percent of the obligation, even though as to the remaining 10 percent there was a U.S. reservation.

Now, of course, there is always the possibility that some country that is anxious to point up what the United States is doing would lodge an objection. The question then would be whether the objecting country was one which had a capability of chemical warfare. If the Ivory Coast, for example, raised an objection and this objection was such as to preclude the Geneva protocol's being binding between the United States and the Ivory Coast, with all respect to that country, I would not regard this as a great tragedy. It would be a tragedy if, for example, the Soviet Union should raise an objection, but I think this is improbable from what I sense of the situation.

RATIFYING PROTOCOL WITHOUT RESERVATIONS

Mr. DU PONT. Well, now taking off your international legal hat for a moment and putting on the hat of a Congressman and policymaker, reading between the lines of your statement I get the impression that you would think as a matter of policy we ought to ratify the protocol without reservation.

Mr. BAXTER. I am only a lawyer, and you know very well, sir, from your own experience with the Harvard Law School that lawyers, for all of their being universal men, also have some modesty when technical and political matters of this sort are involved.

I think probably it would be well to—I am speaking now simply as a citizen appearing before you and with no special knowledge other than what I have picked up from my legal examination of the matter—ratify clean, that is to say, without any reservations. But I would not regard it as a great tragedy if the United States were to ratify

with these reservations, because I think that this would take us 90 percent of the way. That would not preclude a later withdrawal of the reservations by the United States if the executive branch could be persuaded as to that remaining 10 percent.

Mr. DU PONT. And, of course, if we ratified without reservation we would only be committing ourselves to not use riot control agents; for example, on a first-use basis.

Mr. BAXTER. On a first-use basis, that is right.

Mr. DU PONT. That is important.

Thank you, very much.

URGES UNITED STATES GO SLOW ON CW

Have I got time for a question or two of Dr. Price?

Dr. Price, in regard to your policy statements urging at least the United States going slowly, if not going at all in the direction of new chemical warfare agents, I gather from your testimony and some of the people who were before us last week first that it is impossible to define riot control agents out of the larger sphere of chemical warfare agents. In other words, as a technical matter there is no way we can write a law that really defines riot control agents satisfactorily.

Second, I conclude not so much from your testimony, but from prior testimony that it is impossible to police whether another country is, in fact, producing chemical warfare agents because they are too easily produced, the chemistry is too simple, and we have no way to really monitor. Therefore, it would seem to me that we are left in a position of saying that we are going to have to assume that another nation may have these agents and may indeed use them.

The question then becomes, what is the best defense? Shall we put money into defensive capability? Shall we put money into retaliatory capability in kind, or shall we put money into some other kind of capability?

That is a long question, but that is the nub of the problem.

DIFFICULTY OF INSPECTION CAPABILITY

Mr. PRICE. Well, as far as the inspection capability is concerned, maybe I could start there. I think that most of us would agree that it will be very difficult to have a general inspection capability against the general scope of chemical warfare agents. There has been a study financed by, I believe, the Government, on the nerve gases which are perhaps the most toxic, the most lethal chemicals. There has been a proposal made that would enable one with a reasonable degree of monitoring of the chemical element phosphorous and how it is used in a nation's economy to determine whether a large-scale commitment to diverting phosphorous into nerve gases was being made.

So for that particular agent there has been a proposal for a monitoring of what one might call industrial records of the use of phosphorous, and as a way of determining whether substantial amounts of phosphorous were being used in some unauthorized or clandestine development of procurement or stockpiling of nerve gas.

For some of the other weapons this would be more difficult, particularly probably for riot control agents, because in any event riot control agents would presumably be permitted for domestic utilization and for

utilization perhaps within the area of control of a nation even in wartime, as was pointed out by Professor Baxter, so that there would be some production in any event of riot control agents, even if there was an international ban on their stockpiling for use in war.

REQUIREMENTS OF EFFECTIVE INSPECTION

So I think our conclusion is that it would be difficult, if not impossible, to assume that an effective prohibition would be based totally on inspection, and that was the purpose of our comments about balancing the degrees of verification that would be available, and there certainly would be some. Any nation that would make a major effort to produce—certainly our country it is well known that I think with satellite inspection and with other available means of inspection we would have some idea of whether agents were being field tested. I don't think any military would develop and use weapons without field testing them, so field testing is one place.

Production would be hard to hide totally at a major level. The availabilty of information for the defensive preparations would be hard to hide. If a nation was preparing its soldiers or maybe its civilians for protection against agents, this would be very hard to hide.

Presumably, any nation that was praparing to launch an attack would probably consider it wise to prepare its military and civilians for defense in case of an attack of retaliation against them.

So I think this overall answer to your question is clearly 100 percent, absolute assurance that no agent of any kind is being made is unlikely. What we really need to do is to weigh the degrees of verification that would be reasonably possible against the risks of going ahead with the program of escalating or continuing the threat of chemical warfare.

CONTINUE DEFENSIVE PREPARATIONS

Mr. DU PONT. Let's assume that the other side is indeed producing. What is the correct response on our side?

Mr. PRICE. I think our position at the moment would be, too, that we would certainly continue defensive preparations. As you know, when the President announced the abandonment of bacteriological warfare, one reservation was we would continue to do investigations that would prepare to defend against biological weapons that might be used against us. Clearly I could see no reason at all why a prohibition, for example, even much further down the line than the Geneva protocol, the prohibition against the manufacture and stockpiling of chemical weapons, would necessarily preclude research and development and stockpiling of protective measures against chemical warfare, so that one would certainly have that capability available.

The second point, of course, is that we have many other very vigorous military measures that can be taken. I think it is pretty clear that we don't anticipate a tank by tank, tank for tank deterrency in Europe; the Communists have a far greater tank force in Europe than the West has. The deterrent there is the nuclear deterrent, and that is a deterrent of some considerable potency. The question that we raise is whether that deterrent is a sufficient deterrent to negate the significance of chemical warfare weapon for weapon deterrence.

Mr. DU PONT. Thank you. My time has long since expired.
I thank the Chairman.
Mr. ZABLOCKI. Mr. Fraser.

LEGAL CONSEQUENCES OF ADOPTING PROTOCOL

Mr. FRASER. Thank you, Mr. Chairman.

Professor Baxter, I would like to be clear in my own mind as to the legal consequences of adopting the 1925 protocol with reservations. As I understand it, what you say is that if another country objects to our reservations, this renders the protocol null and void for all purposes as between those two parties?

Mr. BAXTER. Yes. It is very much like the law of offer and counteroffer. The reservation constitutes a counteroffer, and it is accepted by silence on the part of the other states to which it is directed. If an objection is raised to the reservation, there are two possible consequences. One is that treaty relationships do not exist as to the particular provision affected by the reservation, the rest of the instrument entering into force between the two states. The other is that the instrument as a whole will not be in force as between the reserving and the objecting states.

The Geneva protocol is so short and so highly integrated an instrument that it is very difficult to think of segregating out the provision which is affected by a reservation and saying that this will not be in force but that all of the rest of the protocol will be. The reservation actually goes to the very guts of the obligation—the type of chemical agents which are covered by the protocol.

EFFECT OF SOVIET OBJECTION

So the effect of a Soviet objection, for example, to a U.S. reservation on this score would be that the Geneva protocol would not be in force as between the United States and the Soviet Union.

Mr. FRASER. Is that the necessary result, or the likely legal construction, say, the International Court of Justice might place on it?

Mr. BAXTER. I think that is fairly clear, sir, because there has been an actual case in the International Court of Justice on this question. I am basing my present remarks on what is said in the Geneva Convention on the Law of Treaties of 1969, which is not yet in force as to the United States but is regarded as a good statement of existing law.

Mr. FRASER. Let's follow that for a moment. Assume that the Soviets object to our reservation and under the reasoning you have advanced this would then mean that both the United States and the Soviet Union would regard the whole protocol as unenforceable as between the United States and the Soviet Union. What about the other contracting parties or signatories?

Mr. BAXTER. The protocol would remain in force as between the United States and all those states which raised no objection to the reservation.

Mr. FRASER. How about with respect to the Soviet Union and other parties?

COMPLEX PATTERN OF BILATERAL RELATIONS

Mr. BAXTER. With respect to the Soviet Union and other parties, the protocol would remain in force in the terms in which it was ratified by the Soviet Union, that is to say, without the reservation. It is a complex pattern of bilateral relationships that is set up.

Mr. FRASER. I see.

Mr. BINGHAM. Would the gentleman yield briefly?

Mr. FRASER. Yes.

Mr. BINGHAM. I would like to say unfortunately I am on a markup in another committee and I will have to leave. I have read these statements and listened to some of the testimony and I am most impressed with both of the statements. I would like to express my thanks to these witnesses for their contribution.

Thank you.

Mr. ZABLOCKI. Proceed, Mr. Fraser.

Mr. FRASER. I think that answers my question. You already said that if no other contracting party or signatory state raises an objection, then the treaty is regarded as modified as between the United States and those parties.

Mr. BAXTER. That is right.

Mr. FRASER. But as between themselves, how does the matter stand?

Mr. BAXTER. As between themselves——

Mr. FRASER. Still the original?

Mr. BAXTER. The Geneva protocol applies in its original form.

INTERNATIONAL OBJECTIONS TO U.S. RESERVATIONS

Might I add one more point to this? If another country were to object to the U.S. reservation, the possibility is still open that the United States could withdraw its reservation at that time, especially if it saw that a large number of states were raising objections and that these were possible users of chemical agents in warfare. Upon reconsideration, we might conclude that the reservation is, perhaps, not as important as we thought it was, withdraw the reservation and, therefore, ratify clean. All of this, of course, would call for a new consideration of the matter by the Senate.

Mr. FRASER. Your objection to the way the State Department is proceeding is that it leaves the U.S. position in doubt. You characterize this full ratification, but with the United States having made a statement as to interpretation that presumably has no legal force?

Mr. BAXTER. It has no legal force in the sense of giving full legal protection to the United States. That is to say, if the matter were ever to be litigated or discussed in any forum which could reach a decision on the question, the U.S. pronouncement would be simply "one man's opinion" and would carry no international legal effect.

Mr FRASER. I assume, however, that if another State decided to use either herbicides or tear gas against the United States, the United States probably could not be heard to say this was a violation of the protocol since we ourselves would have rendered an opinion sanctioning such usage.

Mr. BAXTER. Yes, sir.

PROBLEM OF FIELD TESTING

Mr. FRASER. Dr. Price, you referred to the problem of field testing the binary chemical weapon. Do you know whether it has been field tested yet?

Mr. PRICE. I believe there has been some field testing, maybe one weapon has been tried, but I am not certain of that. I believe that I remember Dr. Robinson saying in his paper that there has been a very small amount of field testing done.

Mr. FRASER. Generally speaking, the Defense Department is reluctant to proceed with production of a system that has not been field tested.

Mr. PRICE. That would normally be the case, yes, sir.

Mr. FRASER. Is there a practical problem that there is no feasible way to test it except perhaps by simulation or something just short of actual full-scale field trial?

Mr. PRICE. Well, my own professional opinion on that would certainly be that one could devise a system for testing these things. There have been many tests of chemical agents performed and to the best of my knowledge there has been only one fairly serious incident, the one which killed the several hundred sheep. By and large the field testing can be done with an absolute minimum of risk, if it is carefully conceived and carried out. I would think this would certainly be possible for the binary mixtures.

RELIABILITY OF SIMULATION TESTS ON BINARY

Simulation is something that I am fairly sure most military officers would be a little reluctant to accept entirely as a true test of the situation. Since these weapons necessarily will carry lighter payloads I would think they would want to be absolutely certain that the load it could carry would be effective. I have not had close contact with the military for a number of years, but when I was active with the ACS Advisory Committee of the Chemical Corps it was clear that testing was an important part of the development, and that testing was done with a live agent in order to be absolutely certain of the effects that could be produced.

Mr. FRASER. Are you generally familiar with the nature of the binary system?

Mr. PRICE. I know the chemical nature of these things, yes, sir.

Mr. FRASER. I think it has been indicated to us that while there are some advantages to the binary system in the safety of transportation and storage, that as an effective agent it may not be as effective as the weapons stockpiled. Do you know whether they may be true?

Mr. PRICE. I would think there would be two possible reasons to support that kind of an opinion. One would be that in order to have a binary weapon you have two chemical agents that mix together during the flight of a shell, for example, or the dropping of a bomb to produce the nerve gas. It also produces an innocuous byproduct at the same time and, of course, you have to carry that innocuous byproduct along with you. You also have to carry along the mixing capability, and it has to be very effective mixing to carry out this chemical reaction in the short time of the shooting of a shell and the dropping of a bomb. So you have a considerably lower weight of total agent that can be

delivered to a target for a fixed weight of a shell or a bomb because of the byproduct that will be wasted and because of the mixing equipment that is necessary.

CHEMICAL SYNTHESIS

I would assume, but I don't know this for a fact, that there may be some effective G agents, nerve gases, which may not be rapid enough for chemical synthesis to accomplish this in the munition. There are some that for which the synthesis can be effectively GB and GV, I guess they are. This can be done.

I would presume, although I again am not absolutely familiar with all of the details here, that there would be some G agents for which the chemistry would not be sufficiently fast and clean-cut to do that synthesis in the few minutes of flight, so you would have that limitation. You might not have all the G agents, all of the nerve gases available in the arsenal as effectively as if you could synthesize them all ahead of time, and you have the weight of delivery problem.

Mr. FRASER. This is essentially nerve gas that we are speaking of, isn't it?

Mr. PRICE. As far as I know that is the major one. I don't think there is any reason why some other agents could not have this capability, but the safety feature is particularly important for the nerve gases becauses of their extreme toxicity even through the skin. You don't even have to inhale a nerve agent to be killed by it, just a drop on the skin is enough. So it is a sufficiently lethal agent if you are unprotected.

LACK OF FIELD TESTING

Mr. FRASER. Do you have any notion as to why the Defense Department is asking for money for production in the absence, or at least what appears to be the absence, of effective field tests?

Mr. PRICE. I must say I cannot support that statement, Mr. Fraser. I don't know what their field testing is.

Mr. FRASER. One other witness who appeared to be knowledgeable indicated that he believed that there had not been field testing.

Mr. PRICE. That may be Dr. Robinson, whose statement is also the one that I was relying on, I am not sure.

Mr. FRASER. I think it was Mr. Pittaway. I don't know if you are familiar with him.

Mr. PRICE. No, I am afraid I don't know him personally, and I really have no personal knowledge on which I can support or deny that conclusion.

Mr. FRASER. One last question. Is it quite clear that the elements that are used in the binary system are perfectly safe prior to being brought together?

Mr. PRICE. Well, they are not what I could call totally innocuous chemical compounds in every case. Let me just make sure I get the initials right for these agents. GB, the two components are difluoromethane phosphine difluoride and isopropyl alcohol. Isopropyl alcohol is innocuous, it is a rubbing alcohol.

COMPLEX PHOSPHOROUS COMPOUND

The methanephosphonyl difluoride would be a very undesirable material to be exposed to. It would be corrosive and highly irritating, and if any of my students were working with it I would make sure they worked with it with caution in a hood. It is by no means as toxic a substance as the agent produced, but it is not innocuous.

The components for the binary VX are very innocuous material, sulfur and a rather complex phosphorous compound which I believe would be relatively innocuous. So I guess I would conclude that for these two agents one of the components would be rather corrosive, one would be susceptible to hydrolysis; that is, it would not be a stable compound but it would not be a compound that I would be particularly worried about my students working with in the laboratory. So there is only one out of those four compounds that I would consider to be something that would be necessary to handle with some care in the laboratory.

Mr. FRASER. I am informed by staff that apparently there were two shells tested in 1969 but none since because of a congressional ban. In your experience would that constitute adequate field testing?

Mr. PRICE. In the light of all of the testing that has been done on the finished agents I would think that the main thing that they would want to be certain of is that the shell had been designed properly so that the chemical reaction was completed by the time of arrival, and I would think you would find that out fairly quickly and fairly easily.

BIOLOGICAL EFFECTS OF AGENT

The biological effects of the agent have been thoroughly explored and earlier tested so it is not as though you would be testing de novo an entirely new agent. I hope that is clear. You are using the same chemical agent, it is the same compound that exists in the existing stockpile, it is merely that you are now synthesizing it in flight instead of synthesizing it prior to flight.

Mr. FRASER. Thank you, Mr. Chairman.

Mr. ZABLOCKI. Mr. Thomson.

Mr. THOMSON. Dr. Price, I wondered if you would answer the question you pose in your testimony. Just how significant to our national security is possession of chemical weapons by a potential adversary?

Mr. PRICE. Well, my personal view is that that is a relatively small threat, and by relatively I guess we have to define it compared to nuclear weapons. The threat of the destructive capacity of nuclear weapons so enormously overshadows any destructive capacity I could imagine from chemical weapons that the nuclear threat, in my opinion, is overhewlming, so I don't view them as a major threat in a surprise attack.

With an enormous weight of weapons you might wipe out a substantial number of Americans, but still only a fraction of the number that would be wiped out by the potential of an all-out nuclear attack. So I conclude that it is a relatively small threat there.

USE OF PROTECTIVE CLOTHING

The other threat that the military worries about as opposed to the threat against the civilian population of the United States is that the use of chemical agents against the military in the field would force them to use protective clothing. They would be adequately protected. There is excellent protection available for, I guess, all the known chemical agents; but, it does restrict or circumscribe the activities of your military to some extent to have to zip up in a protective suit. It is considered by the military to be a detriment to their military capability in the field to have to suit up if the opponents did not have to suit up.

I can't be convinced that that is a major problem, but it would be a relatively minor factor in a military engagement if our troops were forced by enemy chemical attack to suit up and the opponents did not. This is a statement that was made, for example, by Colonel Dismore at the symposium on chemical weapons in Los Angeles.

I find it hard to believe that this would be likely, however, because in any military engagement under those circumstances it might be rather unwise for the chemically offensive group to assume that their troops would be totally unexposed to the agent. If they are going to use this as a surprise effort to take over some territory, for example, or if the weather conditions changed and blew some of the cloud their way, they would certainly have to be prepared to protect themselves against their own chemical agents. Thus, it would be a rather limited kind of target where this inhibition would be a serious one to the attack group.

Mr. THOMSON. What are the hazards of field testing? Are the problems for the civilians?

FIELD TESTING OPERATIONS

Mr. PRICE. Well, my honest opinion is that with any kind of intelligent operation, and I think our Army has used reasonable intelligent operations in the field testing, the field testing has minimal hazard—it got away once and killed some sheep. I think the real political furor about the nerve agents came not from field testing but from the possibility that some of the outdated weapons were going to be shipped by rail and there, of course, exists the possibility of a railroad accident. As you know, there have been accidents in which normally shipped toxicants and lethal chemicals have been spilled and have caused evacuations of large areas of a city or town. I would think that the shipment of the live agents probably poses a greater threat to the civilians than the testing program.

Mr. THOMSON. Well, Professor Baxter, I was just wondering what you would think would be the result if the Senate, for instance, eliminated the exclusion for chemical herbicides and passed good, favorable action and sent it to the President. What would be the result?

Mr. BAXTER. My understanding, sir, is that your question relates to a clean ratification of the Geneva protocol by the Senate. That is to say, the Senate would not accept any reservations or any understandings or irritant chemicals or herbicides.

This really requires two aspects of the matter to be considered. One is if there were actually a reservation framed by the executive branch and the Senate were to reject it, then it would lie in the dis-

cretion of the President whether the United States would deposit an instrument of ratification of the Geneva protocol or not. As I think you are aware, sir, even after the Senate has acted, the President is under no obligation to deposit any instrument. He remains a free agent. If he does accede or adhere to or ratify the treaty, he must do so in the terms approved by the Senate but he need not do anything.

SENATE OPTION ON PROTOCOL

If the Senate were simply to state that it did not share the understanding of the executive branch, then there would be a more complicated situation. I would suppose that if the Senate desired to make sure that the coverage of the Geneva protocol extended to tear gas and to chemical herbicides, the apposite way of going about this would be to add an understanding on the part of the Senate that chemical herbicides and irritant gases are covered by the Geneva protocol. The President would, if he were to deposit the instrument of ratification, have to include that understanding in the instrument, but the President might say that these are unacceptable conditions and conclude that the United States should not become a party to the Geneva protocol. There is nothing other than the exercise of political pressure that the Senate could do about that, sir.

Mr. THOMSON. No appropriation?

[Laughter.]

Mr. BAXTER. Sir, you are wiser in these matters than I am.

Mr. THOMSON. What about the herbicides we had? We opened these hearings with the discussion of the dangers of the herbicides. Are they more objectionable than the gases or equally objectionable, or what is the standing relating to herbicides?

Dr. Price.

VARIETY OF G AGENTS

Mr. PRICE. Well, there are a variety of different G agents that can be used as herbicides, and most of them do have toxicity against humans and animals. Under some circumstances they would be lethal to humans. Under the circumstances which they are generally used they probably have a minimal lethality or toxicity to humans, but do have a toxicity against plants.

So it is again a question of trying to draw a line as to when is a chemical toxic enough to be called a chemical warfare agent. There are many herbicide agents which are highly toxic to humans but which are classified as herbicides because they don't have the other attributes that make them useful in a combatant situation as a chemical warfare agent. So the lethality alone is not the only criteria that is used to decide whether an agent is a useful chemical warfare agent, but certainly many of the herbicides are quite lethal compounds when they are administered to humans under the right conditions.

Mr. THOMSON. Do they get to humans through a chain like fish and fowl and——

Mr. PRICE. Most of them are not stable compounds like DDT which goes through that kind of scheme, but there are many agents that have been used in agriculture which could be called herbicides and others that have gotten to humans by accident—either to the man

who is applying the agent to his crops or through improper cleaning of the crops when they come to be used. So it is perfectly possible that the herbicides can have deleterious effects on humans and there still is a considerable dispute about how serious may have been the genetic effects on the unborn babies from the herbicides that were used in Vietnam.

CONTINUAL GRADATIONS OF CHEMICALS

So in my opinion it gets to be very difficult even for chemists to draw sharp lines. You could pick a compound way over here as safe as a herbicide and you could pick some other herbicides discarded because they are too toxic to man and animal to use, and there are these continual gradations of chemicals that have different degrees of toxicity to different species and even to different individuals of the same species.

This is why we come to the conclusion that it would be much cleaner to eliminate all of these chemical weapons instead of trying to draw some kind of lines which would be at the very best somewhat arbitrary, and where there would certainly be compounds that would be very close to the borderlines on each side. You could pick compounds that would be clearly on the safe herbicide or the safe riot control side, but there would be other compounds that other nations might try to use and call herbicide or a riot control agent that would be much closer to the borderline than other compounds. It is for this reason that we find it very difficult to say that you could draw a clean, sharp line between these different types of chemical agents and that we believe they should all be included in the ban.

Mr. THOMSON. Thank you very much.

Mr. ZABLOCKI. Mr. Biester.

Mr. BIESTER. Thank you, Mr. Chairman.

Most of my questions actually have been offered and responded to already.

I wonder if I might ask how long some of these gases survive in the area in which they—let's take the binary system, the area in which they combine and express themselves. How long does that expression last and how wide an area does it cover?

NERVE GASES VARY IN VOLATILITY, PERSISTENCE

Mr. PRICE. I presume that is addressed to me, Mr. Biester. I think that the answer to that question is that it can vary enormously even for the family of nerve gases, and they vary greatly in their volatility which affects their persistence. If it is a highly volatile agent like GB is, it would vaporize fairly quickly and would be persistent for a matter of minutes or hours at the very most.

There are other much less volatile and more chemically resistant agents which would certainly be able to exist for days in a particular area, so that the volatility and chemical resistance would determine its stability in water, for example, which would be a very important factor. In their persistence they are exposed to water and hydrolized. That would be one way they could be destroyed. Another way is to volatize and disperse.

As far as the extent to which they can be spread, they are not what you would call very widespread. I suppose an artillery shell would cover an area at the most in the range of 100 yards or so with material if you tried to spread it too thin. That is one of the kinds of things that testing has tried to design, how can you get a maximum lethal dose out of a fixed amount of material. In effect, if you spread it too thin it is not toxic, not lethal, so you have to try to tailor the dissemination with the lethal effect of the agent and for nerve agents you could disseminate it more widely because it is so much more toxic than say mustard gas or some of the older toxic agents.

Mr. BIESTER. I take it from the military standpoint the object would be not to have it be lengthy in terms of its duration in time for the set to occupy a portion of the field. The ideal result would be to have it go in and have it active and then have it dissipate with the forces that would occupy that section.

Mr. PRICE. That would be one use, but on the other hand if you were retreating you would like to deny the territory to the enemy as long as possible, so you have a need to have both kinds available.

Mr. BIESTER. I was thinking of occupying.

You have mentioned toxic but not lethal. Is it feasible to find too this kind of reference so that it is toxic but not lethal?

Mr. PRICE. Toxic means any deleterious effect on the body. Even riot control agents you would list as toxic, as they cause vomiting, blistering, or cause an undesirable effect, but are not killing.

Mr. BIESTER. Are not killing.

Mr. PRICE. Certainly there are incapacitating agents which are toxic but not lethal to the majority of the people to which they are exposed.

Mr. BIESTER. In my mind I can put together I guess the reasons for the use of toxic but not lethal or some kind of disabling gas is really not useful in warfare because one can take steps which prevent its being effective on one's own troops and, therefore, there is a kind of 100 percent defense against it and, therefore, not used. Am I correct about that? Is that the reason we didn't use the disabling gas because it is possible for each side to receive approximately 100 percent of defense against it?

DEFENSIVE MEASURES ON NERVE GAS

Mr. PRICE. I really would not believe that that is the best way to put it, Mr. Biester. I think that there are extremely effective defenses to the nerve gases in both the protective clothing and an injection given within 20 or 30 seconds will counteract the effect of the agent. So there are good defenses against the most toxic agent, the nerve gases.*

If you get some mustard gas on your skin and it is there for a minute, I don't know any way you are going to prevent that from becoming a burn that is going to take a month or two to cure. We did a lot of work, and my mission in World War II was a defensive mission to try to find ways to defend against that, and once that had chemically reacted with your skin there was just no way to repair that damage. Protective clothing was protection against it, but once exposed there was no way

*See appendix, page 242, Study on "A Vaccine Against Organophosphorous Poisoning."

to neutralize. If you get it fast enough you can neutralize it, but it has to be within a few seconds, literally.

Mr. BIESTER. Supposing we were to use a disabling gas, not lethal but disabling on the first or second day of the battle. By the third day the defensive forces would be in a position to apply clothing and masks and other kinds of protective material which would generally mitigate against the effectiveness of the gas. Is that correct?

DIFFERENCE BETWEEN INCAPACITATING AND LETHAL GASES

Mr. PRICE. That is perfectly true. There should be ways to defend against any kind of incapacitating or lethal gas. What I didn't say was that I don't see any way I could distinguish in my mind between a difference between an incapacitating gas as against a lethal gas. Of course, if you gave incapacitating gases the men might be back to fight a few days later, whereas they would not be if they had been administered a surprise lethal dose.

Mr. BIESTER. So, therefore, disabling agents as far as the military is concerned are impractical?

Mr. PRICE. I know of no uses of them that have been made in combat.

Mr. BIESTER. I would like to nail this down if I can because you have dealt with defense against gas warfare. I would like to be clear in my own mind that disabling gases are in fact over the long span of duration of a war impractical in effect. If they are, then there is no point in our exploring their use.

Mr. PRICE. Well, I think the thing that buzzes around in my mind on that is that the obvious comparison you are making is between lethal agents and incapacitating agents, and I find the distinction rather hard to make. I think I could devise defenses for my troops against lethal agents just as well as incapacitating agents. I would think that the only real utility of these would be if you could use it in a surprise situation so you could catch the enemy without defenses.

MORALITY OF CW

Mr. BIESTER. But you could only do that once or twice.

Mr. PRICE. Presumably, but that might be critical in a battle like trying to take an island from the Japanese or taking Stalingrad by the Germans. This might have been a critical battle, and if you could have caught them by surprise and won that battle it might have changed the complexion of the war. That would be just as true for the lethal agents as for the incapacitating agents. You would win or lose the battle with either one, the only difference would be whether you actually lost a number of soldiers who would never return to fight another day. In that sense you are correct, the lethal agents would be more effective. If they could be effective at all, they would eliminate the troops permanently.

Mr. BIESTER. I suppose I am asking you to puzzle over something that really can't be solved and that is first of all the relevant level of morality in terms of uses of criteria kinds of weapons in warfare. To say that somehow or other napalm is an appropriate weapon to use to drive an enemy out of a fortified position and disabling gases is not, it seems to me, gets us into some very serious moral questions.

I was thinking in terms of disabling gases because they are impractical of effect and lethal gases because they are of impractical effect, and because they are fundamentally immoral.

RELATIVE MORALITY OF NAPALM, G AGENTS

Mr. PRICE. I completely concur with you on the difficulty of trying to resolve this question on any kind of moral consideration. The question of which agent you are going to use to my mind is almost impossible to resolve on that level. I completely agree with you that making a torch out of a man with napalm is certainly no more moral or immoral than killing him with a G agent, or with a bullet. I just don't see how you resolve the question.

For me, I can't resolve that question by trying to come to some decision that some of these methods of killing or disabling people are more humanitarian than others. I come to a very strong conclusion on the chemical warfare agent on a very different basis, and that is that there is before us an agreement to ban these weapons. If there was an issue before you to ban napalm, I would be just as vigorous to say if we had agreed on that let's agree to ban napalm, but the question before us today is whether we agree to ban chemical agents.

I think if you tried to resolve that on the basis of trying to resolve your own moral views of this you are going to be in real trouble.

Mr. BIESTER. It can't be done.

Mr. PRICE. You can't do it, and I would be very hard put as to how to advise you to do it on moral grounds.

MAJOR POWER SIGNATORIES TO PROTOCOL

Mr. BIESTER. Professor Baxter, as far as reservations are concerned I note that many countries, including some of the major current military powers, have signed the protocol with reservations.

Mr. BAXTER. Yes, sir.

Mr. BIESTER. So that it would not be an unusual act on our part to attach one or two reservations, although I note that most of these are boilerplate reservations about first use.

Mr. BAXTER. That is correct, sir.

Mr. BIESTER. Do you think that it would be appropriate for us to attach a reservation similar to that that the Soviets attached when they ratified the protocol or do you think we should avoid those two reservations?

Mr. BAXTER. Well, I think, sir, that it may already be implicit in the protocol that it binds a state only as to other parties. This is covered by the familiar form of reservation that the protocol apply between the reserving state and the actual parties to the Geneva protocol, so that it is not an obligation owed to the entire world. So far as the reservatons concerning retaliatory use is concerned, I think there is some value in this. If one does not have a provision of that sort, then one gets into a very complex area of the law about what the remedies are for violation of a treaty, especially a treaty relating to the conduct of warfare.

One must consider reprisals and retaliation and retorsion and the doctrines that international lawyers like to write about in books, and

it is very difficult to resolve the matter. The understanding that you are restrained only from the first use of these weapons does leave a sound basis for responding to violations of the treaty by the other body.

IMPLICATIONS OF RESERVATIONS TO PROTOCOL

On the other hand, the danger of such a reservation is if one side uses tear gas, assuming for the moment that that is in violation of the treaty, then no holds are barred so far as the adversary is concerned; and the adversary can, within the terms of the prohibition, respond with nerve gas. That is dangerous.

Mr. BIESTER. I quite agree.

Mr. Chairman, I just have one last question of a technical nature.

Please forgive me, Dr. Price, for asking this, but just for my own information why is napalm not a chemical weapon?

Mr. PRICE. Well, that is a good question, and I think the question has also been asked as to why smoke is not a chemical weapon.

Mr. BIESTER. Or smoke, yes.

Mr. PRICE. I guess that it simply was not defined as such in the Geneva protocol is the only reason I could possibly give you. Napalm was invented by my professor of chemistry at Harvard, so it is a chemical composition. It was designed by a chemist, but it uses heat rather than a toxic chemical agent.

Smoke, I think, actually comes a little more close to this because smoke is toxic. As you know, many firemen are overcome from smoke inhalation. There are chemical inhalations in most smoke, but it was viewed as a screening agent and not as an antipersonnel agent, and I guess for that reason was not included. I would think both of these would be, I hope, subjects that would be seriously considered by future negotiators.

Mr. BAXTER. May I add just a word about that?

Mr. BIESTER. Yes.

WEAPONS WHICH CAUSE UNNECESSARY SUFFERING

Mr. BAXTER. The subject of a ban on napalm has come up, as you may be aware, in the United Nations and is also under consideration by the Diplomatic Conference on International Humanitarian Law, the first session of which was held this year and the second session of which will be held next year.

Under consideration are a number of weapons which are alleged to cause unnecessary suffering or to be indiscriminate in their effects—fragmentation bombs, napalm, other incendiaries. I think even the most ardent advocate of barring napalm has not suggested that napalm falls within the terms of the Geneva protocol. I think napalm is looked upon essentially as a form of incendiary rather than as a chemical weapon, and for that reason as belonging to another family.

Mr. BIESTER. I appreciate that addendum. I find myself thinking in terms of what those who drafted this protocol in 1925 must have had in mind in terms of the objectives they sought and the gravamens they hoped to address and how marginal and small an impact on what they were hoping to accomplish. Their protocol turns out to be nuclear weaponry, not only destroying hundreds of thousands of people at a

stroke but by radioactivity embracing millions in a lethal scientific, if not pharmacological, way. Napalm, which you just described, incendiary weapons on cities, incinerating hundreds of thousands of people—it seems to me your application of this protocol in the face of all of that would be very modest.

Thank you.

Mr. PRICE. I would concur with that comment that it is modest, but I don't mean to say that it is not important.

Mr. BIESTER. I don't mean to leave that impression.

IMPACT OF PROTOCOL ON CW USE

Mr. PRICE. It is important and there has been very little use in warfare since that was drafted in spite of the United States not having ratified it. So it can be given some credit and we ought to make every step we can in the right direction.

Mr. BIESTER. I think it is modest in the terms of what we have been able to use against ourselves since 1925.

Mr. ZABLOCKI. Gentlemen, the questions were numerous and as Mr. Biester has stated, some of the questions he had have already been answered as have some of mine.

However, I would like to pursue a key issue. One of the purposes of these hearings is to explore the reasons why the Geneva protocol of 1925 has not been ratified. We are also interested in learning whether a ban on chemical agents as provided for in the Geneva protocol would be injurious to U.S. national security interests.

Professor Baxter, in your answer to previous questions you have touched on an issue of concern to me. It involves a matter I raised in a question to Senator Nelson, who testified before our committee on May 1. You have stated that 90 percent of the agreement would be better than none—in other words, ratifying the protocol with the exclusions requested by the administration is preferable to not ratifying the protocol at all. My question is whether the Senate could in effect amend the referral of the President containing the reservation of the Secretary of State?

CONGRESS, EXECUTIVE COEQUAL BODIES

Article II, section 2 of the Constitution makes it quite clear that we are coequal bodies, the Congress and the President. In asking these questions it is not my purpose to point the finger on the other body or at the executive branch. As a matter of fact, if the executive branch were more persistent and more active we would have had a ratification of the 1925 Geneva protocol long ago. But it seems to me that article II clearly gives the Senate the constitutional and responsible role of serving as counsellors to the President. What article II, section 2 says is that the President shall have the power, "with the advice and consent" of the Senate to make treaties." Notice it says "advice."

Thus, as I read it, while the President has the final word in such matters he is not a monopoly negotiator. As you noted, the so-called "understanding" or exclusions contained in the Secretary of State's letter was a whisper to the Senate and perhaps not intended to be a full-blown interpretation. Would you then agree that the Senate could take up the Geneva protocol of 1925 and, in its advisory role,

say it does not share the understanding of the executive branch and eliminate the exclusions? The end result might place the President in a difficult position but at least he would have a clear choice.

POSSIBLE SENATE ACTION ON PROTOCOL

Mr. BAXTER. Yes, sir. If the Senate were to express its understanding on this matter the President would either have to communicate that understanding as part of the instrument of ratification, or not deposit the instrument of ratification. He would be faced with a clear choice in such a case.

If the President should, as I indicated earlier, decide that this was an unacceptable understanding by the Senate, then he would be under no obligation to move further except insofar as he might respond to political pressures.

Mr. ZABLOCKI. Mr. Baxter, don't you believe the Executive Department was influenced in its determination to request exclusions by the fact that we were using herbicides and riot control agents in Vietnam at the time. Therefore, the reservation was made to the Senate because of the climate at that particular time. However, since that time changes in attitude and circumstance have taken place. Chief among those changes it seems to me is the fact that only two nations, Portugal and Australia, supported our position on the 1969 U.N. resolution. Now, if the President was sincere in filing the protocol with the Senate and if he takes these changes into account, he may be inclined to accept the Senate amendment of eliminating the exclusions.

TIME GENERATES CHANGES IN ATTITUDE

Mr. BAXTER. Well, there is no doubt there has been a great change in the climate in which this question is being considered, with the ending of the Vietnam war and with the termination of the active employment of irritant gases and chemical herbicides. However, the chronology was that the United Nations resolution came in 1969 and the President resubmitted the Geneva protocol to the Senate in 1970, so that that understanding was already on record.

I think it is only fair to say that a General Assembly resolution of that sort tends to be highly politically colored, but all law is ultimately political in its origin. In addition to the 3 dissenting voices, there were 36 abstentions, which is a convenient way of ducking the issue or expressing reservations one way or the other. The matter is thus not absolutely clear.

I would say that a bloc of 80 votes, including many parties to the protocol, is rather impressive evidence as these things go. I take it too that the climate in which the Senate could act is a good deal more propitious, now that the war in Vietnam is over. However, I am sure that military people would say—some military people at least—that there continues to be a legitimate military use for tear gas and a legitimate military use for chemical herbicides. You would have to ask the experts about those matters, and naturally their views would have to be weighed in the balance.

ALTERNATIVES OF SENATE ACTION

Mr. ZABLOCKI. This leads to another point. It would certainly be more directly defined. The Senate would not necessarily have to completely disagree with the reservation of the Secretary of State but could say in certain instances herbicides and riot gases could be excluded from the Geneva protocol as interpreted by both the Senate and the executive branch.

Mr. BAXTER. That is correct, sir. The Senate could express itself in terms of a declaration statement, interpretation, understanding, or reservation on "riot control agents" and the Senate could put on record what it considered to be the correct interpretation of the Geneva protocol. The President, if he wanted the United States to be a party to the protocol, would have to accept that information.

Mr. ZABLOCKI. In your considered judgment there would be no question of any problem as far as the other signatories of the protocol are concerned?

Mr. BAXTER. Mr. Chairman, the most I can do about that is to make a prediction, and a prediction which comes without the wisdom of the Department of State. That prediction insofar as I do know about the subject matter is that there would probably not be objections raised, that if there were objections raised they would be minimal in number, and that there would be a further opportunity for the United States to reconsider its position if those objections were raised.

NOT TOO LATE FOR SENATE TO ACT?

Mr. ZABLOCKI. So it is not too late for the Senate to ratify the Geneva protocol of 1925 at this time?

Mr. BAXTER. It is not too late, sir.

Mr. ZABLOCKI. We might look back in history, During our 1969 hearings George Bunn of the University of Wisconsin Law School registered some possible reasons why the protocol failed to pass. One reason he analyzed was that the Army Chemical Services, the American Chemical Society, the veterans' organizations, and segments of the chemical industry all opposed it. In addition, the arguments in the Senate were that the protocol would be ignored in time of war, and that in any event poison gas was more humane than bombs and bullets. Thus, the protocol was finally withdrawn from Senate consideration.

Of course your society's position has changed but does a similar situation exist today in your opinion? Is the climate the same?

Mr. PRICE. Could I answer just one other point that we did make on our testimony there, and that is the humaneness question. We dealt with that rather gingerly in our statement, but I would like to express a little more my own personal view about that, and that is in the battlefield situation I think one could rationalize that chemical warfare is no less humane than burning a man with napalm or exploding shells or what other things.

WARFARE MAY INVOLVE CIVILIANS

As the potentiality for warfare has now expanded to encompass the entire civilian areas as well, and it certainly has, then the humane-

ness argument seems to me to be rather thoroughly dissipated, and that is one of the essential points that we want to make in our presentation that has led to the change in the point of view of the American Chemical Society.

Mr. BIESTER. If the gentleman would yield, I think that is a point well taken and a distinction well made.

Mr. PRICE. I wonder if I could comment on the exchanges you were just having with Professor Baxter. I would like to register one point of view as to why the Senate has not ratified its protocol with the reservation expressed by the administration, and I think they go to a point with which I might differ with my colleague from Harvard, and that is whether we are really getting 90 percent of the package if we make those reservations.

I think the point of view that led to the lack of action over the last 3 or 4 years was that the reservations would in fact essentially scuttle the intent of the Geneva protocol. In view of the fact that it is so difficult to precisely categorize a new agent that country *x* makes, if they say it is a riot control agent, is it a riot control agent or is it an incapacitating agent, or is it a lethal agent? If there were a reservation of the kind that it is in the U.S. administration's proposal, it seems to me that any country that then wanted to abrogate the Geneva protocol would label whatever combat weapon it wanted to use as a herbicide or a riot control agent, and it would be very difficult to argue, if it was a new agent, which classification it should really be put in.

IMPLICATIONS OF PROTOCOL RESERVATIONS

If that were in fact the case, then this reservation might lead to a breakdown of the Geneva protocol in the future. If other nations picked up this reservation, it would then become almost impossible to absolutely say in which categories will be placed a new agent that is now devised. It was this kind of reasoning, I think, which led to a great reluctance on the part of many people, who believed in the Geneva protocol, to accept the reservations that were expressed by the administration.

If, indeed, it were a clear and unequivocal case of excluding only 10 percent, and that was clear and unequivocal, I think most people would accept the proposition that we could submit such a reservation; but I think in thinking about that question, I urge you to consider the problem that would arise in the future of trying to draw that line if nation *x* used an agent which it said was excluded, and they said it was a riot control agent and was, therefore, not included in the Geneva protocol but it produced a lot of incapacitation and fatalities. It would lead to a very fuzzy definition, and perhaps not at all the 90–10; it might become almost the other way around if many nations accepted the U.S. position.

Mr. ZABLOCKI. You recall, Dr. Price, in our colloquy I inquired if the Senate could define the protocol to allow herbicides and tear gas in limited use, for example, in connection with civilian riots or riots of prisoners of war trying to escape, or in non-enemy-controlled territory.

Mr. PRICE. I like that very much. Mr. Chairman, I did like that.

BALANCE OF BENEFITS—WITH OR WITHOUT RESERVATIONS

Mr. ZABLOCKI. We get more than 90 percent.

Mr. Baxter, would you care to comment on Dr. Price's observation and difference with your position, or with your anticipation that you would be getting 90 percent of the package if the protocol would be ratified with reservation?

Mr. BAXTER. Thank you very much, Mr. Chairman. I now realize that an attempt to quantify was an unfortunate figure of speech. I only meant that if there is a real stalemate on something of this sort, it is better to get the United States to be a party to the protocol with a reservation than not to have the United States a party to the protocol at all.

I quite agree as to the problems to which Dr. Price has referred. Certainly there is a great danger, if certain categories of chemicals are excluded from the scope of the Geneva protocol, that it will be very difficult to define what conduct is permissible and what is impermissible. There will be a tendency to escalation, with stronger and stronger varieties of gas being used as the use of gas climbs upward. There is a possibility of cheating as well, related to escalation as well as to the question of definition.

Then there is much to be said for the view that a prohibition might be cast in two words—no gas. This is something which sinks into people's minds, which etches itself, blisters itself on their minds, and admits of no compromise and no evasion.

A MATTER OF BALANCING AND CHOICE

Against the simplication of the "no gas" formula, which has much to commend it, must be weighed the military uses which the Department of Defense would seek to retain. That is a matter of balancing and choice.

Mr. ZABLOCKI. At that point would vapor be a gas?

Mr. BAXTER. Vapor of what kind?

Mr. ZABLOCKI. Would it be defined as a gas? The simple definition of no gas, how about vapor? Is it a gas?

Mr. PRICE. In terms of people we speak of chemical warfare as gas in a very loose way, Mr. Chairman. Most of the chemical gases are vapors; most are a liquid. So the term "gas," I think, which Professor Baxter was using, would cover all chemical agents used in warfare.

Before we stop, I would like to add one very strong support for an idea that was expressed by Professor Baxter, and that is the idea that use in war would not include use in territory controlled by the United States. I think you made that point, that the use of a riot control agent in a prisoner-of-war camp which is controlled by the United States, the use of it in a perimeter of a base controlled by the United States, that this is a kind of an exclusion that might make a lot of sense to define, not what is an agent but what does "in war" mean. I thought that was an extremely important point, and might be very useful in resolving some of the conflict on the use of these agents.

BENEFIT OF RESEARCH AND DEVELOPMENT

Mr. ZABLOCKI. Let me ask a very brief quick question. Some of those who were not in support of the ratification say that scientific research

in defense efforts require research and development of offensive agents. Would you agree?

Mr. PRICE. I would think they require knowledge of the possible agents that would be used against us, but I don't think they require the development of a defensive capability.

Mr. ZABLOCKI. There are those that will say binary methods are needed to counter other nations using similar systems. On page 8, you do state that some probably have done so. Have you any evidence of that?

Mr. PRICE. I have no direct evidence, but I could tell you this, that the Nation that has done more work on phosphorous chemistry than any other is the Russians, and if they don't know everything about nerve agents, I would be very much surprised. So I think that they do, indeed, know everything, but I would be very reluctant to accept the proposition that the binary weapons would be more effective than the conventional nerve gases. In fact, it is almost quite the contrary.

The advantages of the binary are safety, but they do not possess greater effectiveness. They are probably less effective on the battlefield. Their advantage is simply safety in manufacture and safety in transporting them to the battlefield. They would, in fact, be less effective on the battlefield than the conventional weapons, because you would have to provide more munitions to get the same amount of agent on the target.

CHANGES IN NATURE OF WARFARE

Mr. ZABLOCKI. May I ask you a very direct question, Dr. Price. In your testimony you note that your society's changed position on the Geneva protocol was a result of "drastic changes" in the nature of warfare. Why do you think our Government has been so reluctant to recognize those changes? I am also prompted to ask, is your society consulted, and if so, to what degree?

Mr. PRICE. Consulted by the Government?

Mr. ZABLOCKI. By the Government.

Mr. PRICE. We for many years had a committee that was related to the Chemical Corps, American Chemical Society Advisory Committee, which essentially ceased to exist when the Chemical Corps went out of existence 10 or a dozen years ago. As far as I know, the American Chemical Society has no direct interrelationship with the military. We do from time to time get consulted by congressional committees, as on this occasion here where the society is consulted, but I would say that to my knowledge any direct consultation that we have had on this question has been minimal.

Mr. ZABLOCKI. I imagine the situation would be different if you were in agreement with them.

Mr. PRICE. That may be, sir.

Mr. ZABLOCKI. Mr. Harrington.

Mr. HARRINGTON. I came in too late, Mr. Chairman, to really ask questions.

Mr. ZABLOCKI. If you have any questions, feel free to ask them.

Mr. HARRINGTON. Thank you.

TESTIMONY HELPFUL

Mr. ZABLOCKI. Gentlemen, this has been a most profitable and very interesting morning, and on behalf of the subcommittee and myself, I want to thank you for your testimony. It has been most helpful. It has injected some views that we presumed were there, but we didn't have them in the record.

Thank you again, gentlemen.

Mr. PRICE. It is a pleasure.

Mr. BAXTER. Thank you, Mr. Chairman.

Mr. ZABLOCKI. The subcommittee stands adjourned until 2 o'clock Thursday afternoon, May 9, when we will hear the following witnesses from the Department of Defense: Mr. Amos Jordan, Acting Assistant Secretary for International Security Affairs; Maj. Gen. H. P. Smith, USAF, of the Defense Intelligence Agency; Maj. Gen. Pat Crizer, USA, of the Joint Chiefs of Staff; and Brig. Gen. Bennett Lewis, USA, of the Joint Chiefs of Staff.

The subcommittee stands adjourned.

[Whereupon, at 12:08 p.m., the subcommittee adjourned, to reconvene at 2 a.m., Thursday, May 9, 1974.]

U.S. CHEMICAL WARFARE POLICY

THURSDAY, MAY 9, 1974

House of Representatives,
Committee on Foreign Affairs,
Subcommittee on National Security
Policy and Scientific Developments,
Washington, D.C.

The subcommittee met at 2:05 p.m. in room 2200, Rayburn House Office Building, Hon. Clement J. Zablocki (chairman of the subcommittee) presiding.

Mr. Zablocki. The subcommittee will please come to order.

This afternoon the Subcommittee on National Security Policy and Scientific Developments resumes its hearings on U.S. chemical warfare policies. The basis of these hearings are resolutions sponsored or cosponsored by some 46 Members of Congress which call for the ratification of the 1925 Geneva protocol and a comprehensive review of our national policies in this area.

Thus far we have heard testimony from interested Members of Congress and a variety of private experts. Today we shall have the views of the Department of Defense.

Our key witness this afternoon is Hon. Amos Jordan, Acting Assistant Secretary of Defense for International Security Affairs. Mr. Jordan is accompanied by Maj. Gen. H. P. Smith, USAF, Defense Intelligence Agency; Maj. Gen. P. W. Crizer, USA, Joint Chiefs of Staff; and Brig. Gen. Bennett Lewis, USA, Joint Chiefs of Staff.

Secretary Jordan, without objection your complete statement will be placed in the record at the appropriate point and you may proceed.

STATEMENT OF AMOS JORDAN, ACTING ASSISTANT SECRETARY FOR INTERNATIONAL SECURITY AFFAIRS, DEPARTMENT OF DEFENSE

Mr. Jordan. Thank you, Mr. Chairman.

It is a pleasure for me to appear before this distinguished subcommittee along with my colleagues to give the Department of Defense's views on the subject of the Geneva protocol. Before I turn to that subject, let me quickly review the U.S. policy on chemical warfare.

In 1969 the President set U.S. policy in this regard when he renounced all biological warfare, and reaffirmed our longstanding commitment of no first use of lethal weapons and extended this to incapacitating chemical weapons and reaffirmed our desire to have effective international arms control measures in this field.

U.S. POLICY AND THE SOVIET THREAT

It is our policy to retain the capability for chemical warfare in order to deter chemical warfare by a potential enemy through the threat of retaliation in kind. We recognize the great effectiveness of these weapons, and the sensitivity of these weapons, and therefore their use requires express Presidential authorization. This policy has been conceived not in a vacuum, but in light of what we believe to be a serious threat posed by the Soviet Union's offensive and defensive capability in the chemical warfare area.

It is, both offensively and defensively, we believe, the best prepared Nation in the world in the chemical warfare realm. The Soviets consider chemical weapons as tactical weapons, and they form an integral part of the Soviet Union's overall capability. They have a very active active research and development program.

We believe that they have developed standardized and stockpiled highly toxic agents for delivery by missiles, aircraft, rockets, and artillery means. Certainly we know the Soviet Union is technically capable of producing sufficient quantities of these very toxic weapons to support full-scale operations. And in their routine military exercises they systematically include practice in simulated toxic environments.

THREAT COUNTERED BY RETALIATION CAPABILITY

In short, their troops are well equipped and trained, have the doctrine and the practice in the use of chemical weapons. U.S. intelligence agencies are unanimous that the threat is real. We believe that in the face of this threat we need to have a capability to retaliate in kind. We note that since World War I highly toxic chemicals have been employed only against nations which lacked a retaliatory capability, and defensive training, and equipment.

We believe that the primary reason why chemicals were not employed against the United States in World War II was our ready retaliatory capability and our defensive measures.

I recently looked up President Roosevelt's very strong statement during the course of that war, which was a clear signal to the Axis powers of the terrible consequences if they were to initiate the uses of chemical warfare.

We believe that even if defensive protective equipment were available the defender would be put at a serious tactical disadvantage if he had only defensive means, and if he could not subject the attacker to a similar loss of tactical mobility and operational effectiveness, the kind that can only be achieved by placing the attacker under the threat of a toxic environment.

MAINTAINING A DETERRENT POSTURE

Lacking the capability to retaliate in kind, the only reasonable alternative to collapse in the face of initiation of chemical aggression against us would be escalation to tactical nuclear weapons. Therefore, if we were to abandon the option of retaliation in kind, we must accept lowering the nuclear threshold. But if we retain this retailiatory option, we believe a potential enemy will be deterred in the use of chemical weapons, and the decision on the uses of tactical nuclear weapons

would then be not forced by these circumstances, but based on the overall conflict situation and on the applicability of nuclear weapons.

In order to maintain this kind of a deterrent posture, we must have a prompt and effective employment capability, which necessitates adequate and appropriate stockpiles. It is only if we can limit the opponent's expectations of significant and timely advantage through chemical warfare that we can expect to deter, to minimize the temptation to resort to this promising expedient.

Our stockpile objectives are based upon the requirements stemming from contingency plans of the Commanders in Chief in the various theaters as a consequence of Joint Chiefs' guidance. These plans consider chemical weapons only when authorized by the President in retaliation. These requirements are submitted annually. Our current stockpile does not fully meet those requirements as we see them.

REASONS FOR THE BINARY

We do have plans, and I emphasize these are only plans, to modernize a portion of our chemical warfare deterrent retaliatory capacity with binary munitions. As you know, the binaries are weapons which combine two relatively harmless chemicals which combine in flight to produce a nerve agent. They have significant operational and safety advantages. Their effectiveness as weapons is equivalent to the current munitions. They use the same agent, the same delivery means, and are designed to give the same target effectiveness.

They do not change the character of the chemical warfare stockpile, but they do produce effective improvements in safety, storage, transportation, and importantly—at some point—provide simple, low-cost disposal. Data on these nerve agents and the binary requirements for producing them have been in the open literature since the 1950's, but the binaries are actually far more difficult to manufacture than present chemical munitions.

The technology of combining these two nonlethal ingredients in the inflight projectile, and so forth, is highly sophisticated; as a consequence, we do not believe that these represent a temptation to proliferation.

SUPPORT FOR EFFECTIVE INTERNATIONAL RESTRAINTS

No administration decision has been made as yet on binary production. No determination has been made that open air testing is required. All testing of the munitions in the open environment to date has used harmless simultants.

The administration is fully committed to achieving effective international restraints on chemical weapons. The draft treaty which was tabled by the Soviet Union in Geneva in 1972 poses prohibition similar to the Biological Weapons Convention, but does not contain verification provisions.

We have been working for a number of years to assess the verification situation for chemical weapons limitation which is much different from that for biological weapons. We had unilaterally renounced biological weapons. We were destroyed biological weapons and verifi-

cation, therefore, was not the important consideration, had it been possible at all, of which there was some doubt.

Chemical weapons, we believe, require effective verification and we have continued to press in this area at Geneva and in other forums because we fully support the notion of effective international restraints in this area.

The President has directed extensive annual reviews of our chemical weapons policy conducted by the National Security Council Under Secretaries Committee, and we have a major review underway at the present time.

ADMINISTRATION'S POSITION ON RCA AND HERBICIDES

With regard specifically to the Geneva protocol, the administration's position on the status of riot control agents and herbicides in relation to the protocol is well stated in the report of the Secretary of State for ratification in 1970, and I quote:

> It is the United States' understanding of the Protocol that it does not prohibit the use in war of riot control agents and chemical herbicides.

This position has not changed.

Riot control agents and herbicides have saved American and Allied lives in combat and could do so again in future conflict situations. The Department of Defense continues to support the immediate ratification of the 1925 Geneva protocol.

We recognize the differences of viewpoint regarding riot control agents and herbicides, and this subject is part of the review by the administration at the present time. But we would urge ratification promptly to remove any doubt about the U.S. legal obligations, and we do believe that ratification would be a progressive step toward other arms control measures.

I am ready for questions. My colleagues here will be happy to share these questions.

I have a written statement which has been submitted and I ask that it be placed in the record.

Mr. ZABLOCKI. Yes; your statement will be placed in the record at this point.

Mr. JORDAN. Thank you.

[Mr. Jordan's prepared statement follows:]

PREPARED STATEMENT OF AMOS A. JORDAN, ACTING ASSISTANT SECRETARY FOR INTERNATIONAL SECURITY AFFAIRS, DEPARTMENT OF DEFENSE

Mr. Chairman, I am pleased to have the opportunity to appear before this distinguished subcommittee to present the Department of Defense views on House Resolutions 679 and 710—resolutions proposing that the 1925 Geneva Protocol be ratified immediately and that the President and the Congress resolve the position of the United States on the future status of riot control agents and herbicides. Prior to reviewing the current U.S. chemical warfare policy, it is, I think, important to reemphasize that the Department of Defense and the administration fully support ratification of the 1925 protocol.

UNITED STATES POLICY

Turning now to a brief review of U.S. policy, in 1969 the President set forth the U.S. policy on chemical warfare as well as renounced all methods of biological warfare. He reaffirmed the long standing commitment that the United States would never be the first to use lethal chemical weapons and extended this policy of "no first use" to include incapacitating chemical agents as well. I should

note that, like nuclear weapons, chemical weapons cannot be employed without expressed authorization by the President. We retain a chemical warfare capability designed to deter anyone from using these weapons against us or our allies. Historically, the use of chemical weapons in war has essentially been restrained by the threat of retaliation in kind. We believe that such a capability for retaliation continues to serve as a deterrent to such use today.

This policy has not been developed in a vacuum, but as a carefully conceived response to the potential threat of a chemical attack against U.S. forces or those of our allies.

The Soviet Union and the Warsaw Pact represent a serious potential threat to U.S. forces in Europe and elsewhere. We believe the U.S.S.R. is better prepared to operate offensively and defensively in a chemical warfare environment than any other nation in the world. They consider chemical weapons to the tactical weapons and subject to the same type of controls as nuclear weapons; their military doctrine views chemical munitions as an integral part of the U.S.S.R.'s overall capability. They maintain active research and development programs on offensive and defensive aspects of CW. We believe that they have developed, standardized and stockpiled highly toxic chemical agents for dissemination by tactical missiles, aircraft, and ground systems such as rockets and artillery. The Soviet Union is of course technically capable of producing all known toxic agents in military significant quantities sufficient to support full-scale operations. Pact major military exercises routinely include practice in a simulated toxic environment (chemical-biological-radiological) and training of chemical forces includes toxic agent exercises. Soviet forces are well-equipped and trained to operate in a toxic environment, either of their own creation or if used against them. The U.S. intelligence community agrees that this threat is real.

I might add here parenthetically that during the October 1973 war in the Mideast, it became clear that the U.S.S.R. had provided the Arabs with CW defensive equipment. Of course, no chemical weapons were used during the conflict. It is significant that a substantial quantity of passive chemical defensive equipment was provided. The captured materiel shows us that new Soviet combat vehicles have pressurized crew compartments and sealed ports for crew firing. I should stress, however, that there were no indications at all that the U.S.S.R. provided her Mideast allies with any offensive chemical capability. However, both Israel and Egypt have the technical capability to produce chemical weapons.

CHEMICAL WEAPONS RATIONALE

Since World War I, highly toxic chemicals have been used only against nations that did not possess a capability to retaliate in kind and adequate defensive equipment and training. It is generally concluded that a U.S. capability to retaliate in kind and in full measure, including defensive measures and equipment, was a primary reason why chemical weapons were not used against U.S. forces in WW II. There are some who question this statement on the basis that there is no conclusive evidence. The same question may, of course, be asked as to any issue of deterrence.

The rationale for maintaining a U.S. chemical weapons capability is based primarily upon the possibility of the Soviet Union initiating the use of chemical weapons in a conventional war against the United States and its allies. The initiator of chemical warfare in a conventional war could gain a significant tactical advantage against the defender if the defender does not have the ability to protect himself and to retaliate in kind or the capability to redress the situation by using nuclear weapons. Even if protective equipment is available and used by the defender, he may still suffer a serious disadvantage in casualties and tactical mobility since his forces would be encumbered by the necessary protective equipment, unless he could subject the attacker to similar severe operational constraints attendant to warfare in a toxic environment. Only a chemical warfare retaliators option provides this capability. Chemical weapons would be targeted against military forces, to produce direct casualties, channelize movement, restrict the use of terrain, interdict lines of communication, and disrupt logistical activities.

Tactical nuclear weapons may not be a credible deterrent to chemical warfare. If chemical weapons were used against United States or allied forces on a significant scale in a conventional war and the United States and allied forces lacked any ability to retaliate effectively in kind, an attempt to redress the situation would probably require the use of tactical nuclear weapons. Abandon-

ment of a retaliatory chemical deterrent, therefore, must accept the possible risk of lowering the nuclear threshold.

A capability to respond in kind, with chemical weapons would not necessarily rule out an ultimate need to move to tactical nuclear weapons but it would provide a nonnuclear option to redress an adverse military situation created by enemy use of chemical weapons in a conventional warfare environment. This ability, we believe, will deter the use of chemical weapons in conventional warfare. Therefore, any determination to use tactical nuclear weapons could be made on the basis of its own merits in light of the overall conflict situation.

JUSTIFICATION OF CHEMICAL WEAPONS STOCKPILE

Since an ability to promptly and effectively employ our weapons, coupled with the will to launch a retaliatory response, is essential to deterrence, the maintenance of an adequate, appropriate stockpile is essential. An adequate CW retaliatory and defensive capability can limit any expectation by an opponent that a significant military advantage might be achieved by using chemical weapons in a conventional conflict. An adequate stockpile that allows timely response reduces to the minimum any tactical advantages to be gained through the initiation of chemical weapons and thus, contributes to deterrence.

The quantity of munitions required for an adequate stockpile is based on the requirements stated by the commanders of the unified and specified commands. The CINC's derive their requirements from applying guidance from the Joint Chiefs of Staff to the particular circumstances in the area of their responsibility. Their guidance requires the CINC's to prepare contingency plans for the use of chemical weapons when authorized by the President in retaliation to enemy use. The requirements to support these contingency plans are submitted annually and are the basis for judging the adequacy of our stockpile.

Our current stockpile of munitions is limited, and does not fully provide the capability we believe is necessary to adequately support all U.S. forces in case chemical warfare is used against us. The composition of our present stockpile does not fully meet our requirements.

MODERNIZATION

To fully provide such a capability, binary munitions are being planned as a means to modernize a portion of our chemical warfare deterrent/retaliatory capability. These weapons are designed to utilize two relatively harmless chemicals which, upon initiation of an event such as the firing of an artillery shell, combine during the flight of the weapon to produce a nerve agent for dissemination upon impact. It provides significant operational and safety advantages over any other known approach which could have been selected for modernization. Operationally, a binary weapon would be shipped and stored in a fail-safe mode, by physically separating the two components. This capability would make possible the safe storage and handling of rounds aboard warships such as aircraft carriers, on transports during any shipments to a theater of operations, and in depots in CONUS or overseas. Additionally, because the binary components are relatively harmless, the requirement for high-cost toxic production and transportation facilities would be eliminated. At the same tme, simplified low-cost demilitarization procedures could be utilized. The agents produced by the binary reaction would be the same as those in our current chemical weapons stockpile. We deal with a new manufacturing, storage, and transportation process not a new agent or new delivery means. Secondly, the binary munitions are designed to assure a target effectiveness equal to the nonbinary rounds which will be replaced. This design compensates for the fact that the chemical reaction between the two binary intermedite compounds will yield less than 100 percent of the lethal agent on target.

Introduction of binary weapons into the U.S. deterrent/retaliatory arsenal has been in planning for practical reasons, to modernize our capability. No claim has been or is being made that binary weapons are more effective on the battlefield than nonbinary systems—rather, it is a fact that in the process of modernization we have elected an approach which will resolve many operational, safety and administrative problems previously associated with chemical weaponry.

The use in a chemical warfare environment of binary weapons would be no different than the use of nonbinary weapons since both employ the same nerve agent to produce the same battlefield effect.

Notwithstanding assertions to the contrary, we do not believe the procurement of binary munitions will increase the access of small nations or dissident groups to the technology necessary to produce a nerve agent. Both nerve agent and binary technology have been reported in the open literature since the early 1950's. Accordingly, any nation or group having competent organophosphorus chemists could have prepared compounds analogous to the nerve agents, including the binary components. As a matter of fact, actual binary munitions, in contrast to nerve agent precursors, would be far more difficult to manufacture than present chemical munitions.

Before I leave the subject of binaries, I should point out that these weapons are still in development and no administration production decision has yet been made beyond Department of Defense advance planning for the loading, assembling, and packaging facility. Further, the Department has made no determination that open air testing of the complete binary round will be required to prove military effectiveness. To date, testing has been conducted using harmless materials simulating the binary process which, combined with closed chamber and laboratory experiments, may well demonstrate the necessary degree of confidence of weapon effectiveness.

ARMS CONTROL

The administration remains fully committed to achieving effective international restraints on chemical weapons. The U.S. formally undertook this obligation in 1972, in signing the Biological Weapons Convention that was negotiated at the Conference of the Committee on Disarmament in Geneva. The Biological Weapons Convention was transmitted to the Senate in 1972 for its advice and consent to ratification.

In 1972, at the CCD, the Soviet Union tabled a draft chemical warfare convention—a comprehensive chemical prohibition. However, the Soviet draft does not contain adequate verification provisions. As you are aware, the adequacy of verification is a very important consideration not only in negotiation of arms control and disarmament agreements, but also in building the confidence in compliance that is essential to such an agreement being more than a piece of paper. The problem of adequate verification for possible chemical weapons limitations has not yet been resolved. This Government is continuing is efforts to find such a solution.

The verification provisions of the Biological Weapons Convention would be inadequate for a chemical weapons limitation agreement. At the time this convention was negotiated, the U.S. had unilaterally renounced the use of and the capability to use biological weapons in any form, and was in the process of destroying its biological weapons when the treaty was negotiated. Reliable verification of other countries' actions regarding biological weapons was deemed not possible, but verification procedures were not an important consideration in this case, because of our unilateral renunciation. Unlike biologicals, chemical weapons are of military significance, have been used in this century, and could offer the initiator a significant tactical advantage. We therefore believe any chemical weapons limitations should have more effective verification provisions.

CHEMICAL WARFARE REVIEWS

In addition to the President's decisions of November 25, 1969, reaffirming the renunciation of the first use of lethal and incapacitating chemical weapons and all uses of biological warfare, the President directed an annual review of all activities in this area. The NSC Under Secretaries Committee, an interagency group, has conducted these reviews of all aspects of our chemical warfare, biological research, herbicide and riot control agent programs. Additionally, in compliance with Public Law 91–121, the Department of Defense has provided to the Congress semiannual detailed reports of the research and development programs and of procurement obligations each year since enactment of the legislation. The most recent report to the Congress covered the period July 1 to December 31, 1973. To insure that these reports are available for public scrutiny, the last two have been completely unclassified.

GENEVA PROTOCOL

One of the issues we are considering today is ratification of the Geneva protocol of 1925, which in effect prohibits the first use in war of poisonous, asphyxiating or other gases and biological methods of warfare. The administra-

tion's position on the status of riot control agents and herbicides in relation to the protocol is well stated in the report of the Secretary of State; which accompanied the submission of the Geneva protocol to the Senate for ratification on August 19, 1970. I quote, "It is the United States understanding of the protocol that it does not prohibit the use in war of riot control agents and chemical herbicides." This position has not changed.

Riot control agents and herbicides were used by American forces in Vietnam. Riot control agents have been used for police purposes by many nations of the world. We have found that use of riot control agents in combat operations clearly reduces casualties among friendly troops, can permit extraction of civilians who may be under enemy control, often without casualties, and can allow the enemy the option of capture rather than casualties. It permits the quelling of riots in prisoner of war camps without the use of deadly force. Herbicides are capable of producing a significant improvement in vertical and horizontal visibility in the type of jungle found in South Vietnam. We believe our use of riot control agents and herbicides was appropriate and had one purpose—to have the lives of Americans and those of our allies. We believe they could prove useful in possible future conflict situations.

In summary on this issue, Mr. Chairman, the Department of Defense continues its support of the immediate ratification of the 1925 Geneva protocol as submitted to the Senate. Of course, there are differences of viewpoint regarding riot control agents and herbicides; and, as you know, this subject is under review by the administration. Ratification of the protocol would remove any possibility of doubt about the United States' legal obligations and would be a progressive step toward other arms control measures.

Mr. JORDAN. Thank you.

EXECUTIVE REVIEW A TIME FACTOR IN RATIFICATION

Mr. ZABLOCKI. Thank you for your statement, which is, as expected, in defense of the present administration position.

In your very closing sentence you state, "Of course there are differences of viewpoint regarding riot control agents and herbicides and this subject is under review by the administration."

I presume it has been under review since the Senate had sent a letter with regard to the Secretary of State's interpretation of the Geneva proctol of 1925, therefore, for at least the last 2 years.

My question is, How much longer do you think the executive branch must review the issue in order to obtain what you say in the next sentence, that "ratification of the protocol would remove any possibility of doubt about the United States' legal obligations and would be a progressive step toward other arms control measures."

In view of that last observation, is it not preferable that the executive branch would change its position on the exceptions? After all it has been demonstrated that use of herbicides and the riot control agents are not that necessary nor so successful in military use. And, secondly, what would be the position of the Department of Defense if the Senate decided to ratify the Geneva protocol of 1925 without reservations?

Mr. JORDAN. Mr. Chairman, I can understand the impatience.

We have had this subject under review for several years. I can only say that at this juncture we are in the midst of a very comprehensive recently initiated review. I would expect this review to be consummated in the relatively near future. I think it is unfortunate that the results of the review will not be available for a few months.

Mr. ZABLOCKI. Forthcoming, do you say, in a month or two?

Mr. JORDAN. Yes.

Mr. ZABLOCKI. That is encouraging.

CONGRESS A COEQUAL BODY

Mr. JORDAN. This has not been a long-range, low-key effort, but an intensive review after which we should expect to produce answers relatively soon.

Mr. ZABLOCKI. Would it be the DOD's position that the Senate should not even wait that additional month or two, but go ahead and ratify the protocol without reservations?

Mr. JORDAN. The Department of Defense would not have an independent view on this, Mr. Chairman. I cannot speculate on the outcome of the review or the administration's ultimate position.

Mr. ZABLOCKI. The Department of Defense, however, as well as the Department of State, would have an input.

Mr. JORDAN. Of course.

Mr. ZABLOCKI. Would you advise whether the Department of State would recognize the Congress as a coequal body, and whether the decisions of the Senate could possibly be instrumental in reviewing the DOD's position?

Mr. JORDAN. I think that we are moving rather quickly to a new look on the part of the administration as a whole. I would hope that the Senate would not move unilaterally contrary to the President's recommendation without having benefit of this review.

FUNDS FOR LEADTIME ITEMS

Mr. ZABLOCKI. Well, in view of your advising the committee that you were progressing rather intensively on the review, then how do you justify the request for authorization and appropriation for the binary system?

Mr. JORDAN. The binary system is a lethal system which will take many years to bring into full operation. We were discussing RCA's and herbicides.

Mr. ZABLOCKI. Exactly, exactly, sir.

Mr. JORDAN. What we seek are long-lead-time items which, if not now authorized on a very modest scale, would preclude the modernization of our stockpile on into the indefinite future in the event we are unable to move to something meaningful in the current conference of the Committee on Disarmament talks in Geneva. We see no point in such a unilateral freeze.

Mr. ZABLOCKI. So you want to go ahead with the binary before it is frozen?

Mr. JORDAN. A decision to go ahead with the binary has not been made, Mr. Chairman. The research and development is going forward and we seek procurement of certain long-lead-time items, but no procurement decision has yet been made.

PROTOCOL UNRELATED TO BINARY ISSUE

Mr. ZABLOCKI. Well, if an agreement is reached on ratification of the Geneva protocol of 1925 which would exclude herbicides and riot control agencies, do I understand you, Mr. Secretary, to say that this would probably jeopardize the continuation of the DOD in a binary system?

Mr. JORDAN. No, I didn't mean to imply that.

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Mr. ZABLOCKI. You said any agreement might postpone U.S. activity in this modernization for an indefinite time, if I quote you correctly?

Mr. JORDAN. No, I am afraid there has been a misunderstanding between us on this point. I was saying that it did not seem logical to continue to postpone development of the binary system awaiting the possibility of agreement on verification measures in the current Geneva CCD talks. By talking about that in the same paragraph or even sentence as the Geneva protocol I misled you.

Mr. ZABLOCKI. I see.

Mr. JORDAN. The Geneva protocol does not relate to the binary system issue.

IF THERE IS AN AGREEMENT

Mr. ZABLOCKI. Now, let's reverse the presumptions. If there is a Geneva agreement at CCD on the chemical systems?

Mr. JORDAN. On the total ban on chemical systems?

Mr. ZABLOCKI. On the total ban, the binary system would not be necessary?

Mr. JORDAN. That's right, exactly.

Mr. ZABLOCKI. Exactly. So let's move ahead in one direction. As you say, we are hopeful this will happen. As you say, some decision will be forthcoming in a few months, or a month or two.

Mr. JORDAN. The question of the production of binaries, for instance, might be decided. It is the whole American chemical weapons policy that is under review.

Mr. ZABLOCKI. Now I interpreted, Mr. Secretary, that there would be forthcoming some decision of position of the executive branch on the exemptions within a month or two.

Mr. JORDAN. The question of our understanding of the Geneva protocol is one part of our analysis.

Mr. ZABLOCKI. Well, so in a month or two we may see daylight. Very good. I have just one more question.

DO THE SOVIETS HAVE A BINARY SYSTEM?

On page 2, Mr. Secretary, you state, "We believe that they have developed, standardized, and stockpiled highly toxic chemical agents for dissemination by tactical missiles, aircraft, and ground systems such as rockets and artillery." The "they," I presume, are the Soviets. Do they have to your knowledge a binary system planned on a drawing board?

Mr. JORDAN. We have no information to that effect. As I noted in my summary, there has been open literature available on binary possibilities for many years.

Mr. ZABLOCKI. Well then, if we presumably continue in the binary system, albeit on a very low scale, this could jeopardize any kind of a solution or agreement in Geneva?

Mr. JORDAN. No, I don't believe that that is the case, Mr. Chairman. The Soviet Union may not need binaries. It is not constrained in transportation and storage to the extent that we are.

Mr. ZABLOCKI. Well, I am sure if you say go ahead with the binary system, it will be much more difficult to verify, and they will then take the position that we normally take, that verification is a problem.

Mr. JORDAN. We would like the Soviet Union to take the verification problem seriously, Mr. Chairman. We would also hope that the possibility that the United States might engage in binary production would cause them to think seriously about verification problems. Our basic difficulty has been their unwillingness to address this problem seriously.

VERIFICATION OF THE BINARY

Mr. ZABLOCKI. Well, they could also go full steam ahead to a binary system to stay in step with the difficulty, or to hide any, and to make verification more difficult?

Mr. JORDAN. We don't believe that verification is ultimately more difficult with binaries. It is the production of the same agent. The particular technological processes by which you get the agent are not likely to be the subject of intermediate verification procedures in any case.

Mr. ZABLOCKI. Well, I am very pleased to hear that. I think you are the first witness, Mr. Secretary, who has stated that the binary system would not increase the verification problem?

Mr. JORDAN. No, I hope that I didn't say that. All chemical weapons pose serious verification problems.

Mr. ZABLOCKI. What I understood you to say was that the binary did not add to the verification problem.

Mr. JORDAN. We have no reason to believe this would be, on balance, appreciably more difficult than the verification of the current weapons.

Mr. ZABLOCKI. So even with the clarification, I must still submit that you are the first witness that maintained this position.

Mr. du Pont.

CHEMICAL RESPONSE NOT ESCALATORY

Mr. DU PONT. Thank you, Mr. Chairman.

Mr. Secretary, your whole case for chemical warfare agents and the production of them in this country seems to rest on the theory that a chemical warfare response is a more effective deterrent, or perhaps I should say more appropriate deterrent, than a nuclear response in case we are attacked with chemical weapons.

Now, why do you think that is true?

Mr. JORDAN. We believe that a nuclear deterrent might not be appropriate to particular circumstances. Furthermore, the nuclear threshold is a terribly significant threshold; it is one that we would prefer not to be forced to cross.

Mr. DU PONT. No, it is a psychological threshold, am I correct? And I know very little about tactical weapons, but am I correct that the physical threshold for tactical weapons may indeed not be much different from the physical threshold for chemical warfare agents?

Mr. JORDAN. They are quite different. There are many different kinds of weapons and I am not sure that a comparison of the weapons' effects on the ground is the relevant comparison—it is what one contemplates as the escalatory possibilities. We don't believe that a chemical response is inherently escalatory. We are fearful that a nuclear response could be so conceived.

I should ask General Lewis, my colleague from the Joint Chiefs of Staff, to expand on this point if he would like to.

AN OPTION TO NUCLEAR RESPONSE

General LEWIS. Clearly there is a major psychological difference.

Mr. DU PONT. Are you sure, General, which way that cuts?

General LEWIS. No, I am not. I would say there is also a physical difference, and I am not sure which way that cuts. This is a judgment area where you can't really quantify the difference in thresholds as perceived by an attacker. There is a significant difference, however, between a cloud associated with a nuclear weapon and a chemical weapon going off.

Mr. DU PONT. Well, I will concede that.

Mr. JORDAN. The important point, if I may add, Mr. du Pont, is that a chemical response provides an option short of the nuclear one. It does not force one to cross the nuclear threshold to have a deterrent capability. This particular deterrent capability is inherently nonescalatory. These are only tactical weapons for employment against military targets. Nuclear weapons go all the way to massive city busters.

Mr. DU PONT. Well, probably there are more strategic nuclear weapons than there are cannisters of chemicals.

Mr. JORDAN. No, far, far from it, sir.

RETALIATION CAPACITY NOT A "MIRROR" IMAGE

Mr. DU PONT. From that standpoint, you are probably correct. But let me go on. When you talk about a retaliatory capability now, are you really talking about having to have a cannister-for-cannister capability? In other words, must we match precisely the munitions that the Soviet Union apparently has?

Mr. JORDAN. No, our retaliatory capacity is not predicated on any mirror imaging—it is not a one-for-one policy.

Mr. DU PONT. Just so that there is some chemical responsibility available?

Mr. JORDAN. Some substantial chemical capability; a substantial chemical capability to force the attacker to realize he is not going to gain a significant advantage either by casualties or by forcing us into defensive equipment which would seriously degrade the military capacity of a defending force.

Mr. DU PONT. We are a little bit outside of our jurisdiction here in talking about appropriations matters, but could you give us any kind of an estimate as to what a substantial chemical responsibility would cost us? Are we talking about $1 billion, $10 billion?

Mr. JORDAN. I cannot be too precise in this area. I don't know. I think that in this whole area estimates are not precise. But, if you prefer, in closed session we can have some discussion on that.

COMPLEXITY OF BINARY AND THE QUESTION OF VERIFICATION

Mr. DU PONT. All right. And one final question on binaries. In going back to the chairman's comments on inspection, if the binaries can be stored separately, and only mixed on actual firing, isn't it also possible to manufacture them separately, for example, on the east coast

and the west coast of the United States in such a way that inspection or verification would be virtually impossible?

Mr. JORDAN. Inspection or other means of verification of the production of the raw chemicals would admittedly be difficult. On the other hand, the technology of bringing these together in the appropriate combat mode is a very complex technology. This munition is presumably an area in which verification would be simpler than verifying the simple filling of a hollow shell with a so-called neat agent of the current kind.

So the verification problem becomes a different problem in the case of binary production than in the case of the current type of weapon, but not necessarily more difficult.

Mr. DU PONT. Are you saying that the actual ordnance manufacturer, as opposed to manufacture of the agents themselves, is of such complexity that that verification is possible?

Mr. JORDAN. That is the point. I should add also that one of the agents that is combined in this binary process is not a commercial agent, so that the verification of the production or nonproduction of that should not be intrinsically more difficult than the production of a current neat chemical.

CHEMICAL PLANT INSPECTION

Mr. DU PONT. But when you are talking about verification, you make it sound as though we are going to be able to inspect Soviet chemical plants and they are going to be able to inspect ours. That doesn't seem very likely. Really when you are talking about verification, you are talking about satellite photographic technology and so forth, and there is no way that you are going to be able to detect these by that kind of policy, am I correct?

Mr. JORDAN. I should perhaps ask my colleagues here if they would like to expand on this point. It is a relative matter but it is my understanding that verification of compliance with a production ban, for example, of the current weapons could not be accomplished by national means either.

Mr. DU PONT. I agree with that.

Mr. JORDAN. I think that we are not in a qualitatively different situation. And as I stated in an earlier answer to Chairman Zablocki, the whole verification process is extraordinarily difficult. We have some hope that the concepts the Japanese tabled in Geneva in April looking at some verification measures may move us a step forward in this area. We have been working very hard on verification.

I do not say that an onsite inspection of every chemical plant in the Soviet Union is required under either mode, but it is obvious that there is going to have to be more than national means, with or without binaries.

Mr. DU PONT. Thank you. Thank you, Mr. Chairman.

Mr. ZABLOCKI. Thank you, Mr. Bingham.

NO DEFENSIVE CAPABILITY 100 PERCENT EFFECTIVE

Mr. BINGHAM. Thank you, Mr. Chairman.

I am interested, Mr. Secretary, in your analysis of this matter of deterrent. It seems to me that in your analysis you stress what is really an operational capability of response by chemical warfare means to

a chemical warfare attack, and you suggested that is the effective way to deter a possible chemical attack. But you have also stated, for example, that the Soviet forces are well equipped and trained to operate in a toxic environment either of their own creation or if used against them.

That being the case, it seems to me that this is not a very effective deterrent and I would suggest to you that far more effective would be if it were known that we did not have chemical warfare capability to respond to a chemical warfare attack that the response would be nuclear.

Would you comment on that?

Mr. JORDAN. Well, clearly the Soviet Union is well equipped defensively. However, I think it should be understood that even with a good defensive posture, including equipment, training, and doctrine, having to operate with this defensive equipment seriously degrades the capability of a force. Furthermore, there are no 100-percent effective systems. If a lethal cloud stays in place long enough under the best of defensive measures there will be serious casualties.

WEAPONS SYSTEM EQUATION

Mr. BINGHAM. Couldn't you use the same argument about any type of tactical operation? Couldn't you use the same argument with respect to tanks and planes, that if you know those types of weapons systems are going to be used against you, you don't use them? I just don't follow the logic.

Mr. JORDAN. Of course, what we are talking about here is a weapons system which is stockpiled and for which there is training and doctrine, but which has not recently been in use. The question is whether a new weapons system—nuclear—should be introduced into the equation. The one for one, or like for like, kind of retaliatory capacity, which is inherently nonescalatory, seems to us to be the most logical kind of deterrent against chemicals.

But let me respond to the second part of your question.

Mr. BINGHAM. Please.

Mr. JORDAN. If you disarmed chemically, would not that prove to the enemy that your response would be nuclear? I think if there were significant nuclear advantage to the defender, so that he could contemplate a retaliation against the attacker which would not likely result in a counternuclear retaliation, and the subsequent risks of escalation, that would be a good response?

In the days when the United States had a monopoly or virtual monopoly on nuclear weapons, that rationale would certainly be persuasive. Given the present distribution of nuclear strength, I do not believe that it is now inherently credible.

Mr. BINGHAM. Yet, we rely on that deterrent very substantially to prevent the other side from engaging in nuclear attacks?

Mr. JORDAN. Nuclear, exactly.

Mr. BINGHAM. Why not put the chemical warfare in the same part of the equation, and the same deterrent applies?

Mr. JORDAN. The question is, would it be persuasive? We are by no means convinced that it would be persuasive, given the inherent escalatory dangers of nuclear weapons and the essential equivalence, in strategic nuclear matters, between ourselves and the Soviets.

PREPOSITIONING BINARIES IN EUROPE

Mr. BINGHAM. Let me turn to another aspect.

I take it that one of the benefits of the use of the binary system is increased mobility and increased capability of transporting these weapons in peace.

Is it contemplated that, if developed, these binary systems would be, for example, transported to Western Europe? And if so, have we consulted with our European allies about that?

Mr. JORDAN. That is a subject, Mr. Bingham, I would prefer to deal with in closed session, if I may.

Mr. BINGHAM. Could you answer this?

If no decisions have been made about prepositioning of these weapons in Europe, is there a justification for moving ahead with it?

Mr. JORDAN. That is part of the same general topic, Mr. Bingham.

A MATTER OF MODERNIZATION

Mr. BINGHAM. Very well.

I understand that you also are arguing for the binary system as a matter of modernization. But I gather that the problem that you confront as far as modernization is concerned is primarily with regard to the M–55 gas nerve rockets and M–34 gas cluster bombs, which have deteriorated over a period of time; but that your contemplation now is to move into the area of binary munitions as far as artillery is concerned.

That would not seem to be geared to modernizing those types of weapons that need modernization.

Mr. JORDAN. May I ask General Crizer, whose expertise goes beyond mine in this area, please?

General CRIZER. The modernization we are programing is in the artillery area. That is not to say that in the future, we would not need to modernize these other areas.

We are talking about a planning program over many, many years. How much do we have; when does it become obsolete; when do you de-mil and at what cost—these are the elements for determining future programs.

What I am saying is, our current technology has been put into our artillery shell. We have not proceeded into the other areas at this time.

MOTIVATION OF THE BINARY SYSTEM

Mr. BINGHAM. But the problem, there, if I am correct, is not one of deterioration of your existing weapons stocks, is that correct?

General CRIZER. This is lead technology in our artillery shells. I am not prepared to say how far we are going to go yet because we haven't made all the plans in these other rounds. We hope in the future this might be applied to the other delivery means as well.

Mr. BINGHAM. I am still not quite clear to what extent.

Let me put the question this way. The rockets and cluster bombs have been subject to deterioration because of corrosion and so forth.

To what extent is that a motivating factor in your desire to move ahead with the binary system?

General CRIZER. We, of course, started thinking along the requirements in the binary area long before this deterioration of M–34's that you spoke of occurred. We were thinking about this in the technology back in the 1960's for reasons associated with transportation and storage, including safety of shipboard munitions. I don't think you should tie the modernization of artillery shells directly to the M–34. I think this deterioration occurred later.

Mr. JORDAN. I would like to add, Mr. Bingham, that modernization is not expected to necessarily proceed on a round-for-round, type-for-type basis. We need versatility in our stockpile and the present mix of weapons in the stockpile is not necessarily optimal for the requirements ahead.

Mr. BINGHAM. Thank you. That is all for now, Mr. Chairman.

Mr. ZABLOCKI. Mr. Frelinghuysen.

U.S. CAPABILITY BEING REEVALUATED

Mr. FRELINGHUYSEN. Thank you, Mr. Chairman.

I must say I have listened with interest to this discussion but I feel I would really need to be a member of the Armed Services Committee to understand fully what we are talking about.

I am a little uneasy about some of the statements made so far.

You mentioned, for example, that our current stockpile of munitions is limited and does not fully provide the capability we believe is necessary to support adequately all U.S. forces in case chemical warfare is used against us.

To begin with, do we need such a capability to support all U.S. forces? Is that the nature of the limitation on our capability which worries you?

Just exactly how adequate is our stockpile? You have said it needs to be diversified. Is that part of the problem, or is it total numbers? In short, what exactly are we talking about?

You also talk about the chemical warfare capability of the Soviets, both offensive and defensive terms. Do we know how adequate their stockpile is or how diversified it is? In other words, are we talking about a situation of potential U.S. inferiority or actual U.S. inferiority? How much of a threat is this situation to our own national security?

Mr. JORDAN. I will ask General Lewis to extend my remarks in this regard. This is in his area of expertise.

But our stockpile, our current stockpile, does not meet the objectives which had been set by the Joint Chiefs in all regards. That is what is intended by the statement. And, as I say, we are in the process of reevaluating those needs and the capabilities that we now have, since the mix of weapons is not optimal. We have an inherited mix.

So, we have both sets of problems, the overall requirement and the appropriate mix to meet it. But I should ask General Lewis to extend those remarks.

THEORETICAL BASIS OF STOCKPILING

General LEWIS. The requirement which is used as the theoretical basis of the stockpile is developed from a series of contingency plans

that are prepared by the unified and specified commanders around the world. They prepare these plans in accordance with guidance from the Joint Chiefs of Staff—guidance which reflects the policy of no first use. We seek only a retaliatory capability to deter the enemy from using CW against us.

Mr. JORDAN. And express Presidential authorization?

General LEWIS. And, of course, CW would not be used without express Presidential authorization.

Now, these plans are presented to the Joint Chiefs of Staff and reviewed. In considering each of the plans, a stockpile is developed, not to meet all of them, but to meet the most likely. If all the contingencies happen to occur, all of the stockpile would be exhausted.

We are prepared to and would be very happy to present to the committee in closed session the match or mismatch between the stockpile and the requirement.

DECREASE IN CW STOCKPILES

Mr. FRELINGHUYSEN. I am still not sure what we are talking about.

Is it the composition of the stockpile, or its overall adequacy; or is that the same thing? Is there an inadequacy because the composition is wrong?

General LEWIS. The stockpile is inadequate both because of composition and because of quantity.

Mr. FRELINGHUYSEN. It is partly a question of quantity. Has the stockpile—our stockpile—changed significantly over a period of years?

General LEWIS. Sir, it has been going down, I believe, since 1958. I would like to check that date.

Mr. DU PONT. Would you yield, on that point?

But one of our early witnesses, and I believe the chairman alluded to this earlier, testified that the stockpile was now four times what it was following the end of World War II.

General LEWIS. The stockpile has gone down. We now have about one-fourth of the agent we had at the end of World War II.

Mr. JORDAN. We have not procured any new chemical munitions since 1968. We have not been building up our stockpile.

Mr. FRELINGHUYSEN. May I assume this was because we decided we had enough quantitywise, or why?

General LEWIS. No, sir, for other reasons. It was decided not to fill munitions. Production plants were shut down. A large part went in bulk storage. What is in bulk storage cannot all be used directly against the enemy.

DEFENSIVE R. & D. 2 TO 1

Mr. FRELINGHUYSEN. How adequate, and how important, is the U.S. chemical warfare defensive posture? Your testimony seems to imply that the ability to retaliate is an essential part of our defensive posture. But, how do we divide our effort in this field? Do we try to develop adequate defensive mechanisms or do we spend most of our time trying to develop strong retaliatory mechanisms?

Mr. JORDAN. We have been working on both, Mr. Frelinghuysen. We have been focusing in research and development almost 2 to 1 in recent years on improving our defensive capability and we recognize that we still have some way to go in that.

We are continuing to work in that area.

Mr. FRELINGHUYSEN. How much do we know about the potential enemy's capabilities both defensively and offensively? I suppose the only other one we would be talking about is the U.S.S.R.

How can you tell that they are better prepared than anyone else? How do we actually know they can operate offensively and defensively better than any other nation in the world?

Do we know much about what they have got?

Mr. JORDAN. Yes. We know from exercises that they anticipate the possibility such weapons might be used.

We know a great deal about their defensive capability; we know less about their offensive capability. We have representatives of Defense Intelligence Agency here who would be happy to provide details in closed session.

Mr. FRELINGHUYSEN. In that case, I have no further questions.

Mr. ZABLOCKI. Mr. Biester.

Mr. BIESTER. I have no questions.

QUANTITY OR LETHALITY

Mr. JORDAN. May I say, Mr. Chairman, with regard to Mr. Du Pont's question about a witness testifying that our stockpile is currently greater than the World War II period, or the end of World War II. As General Lewis said those figures are in error, but we will research the question. (DOD advised the committee that research confirmed the almost 75 percent reduction in worldwide stockpiles since World War II when the worldwide inventory exceeded 100,000 tons.)*

Mr. DU PONT. That was testimony by Mr. Perry Robinson and I am sure the committee would be happy to have your research on that.

GENEVA PROTOCOL: U.S. POSITION IN THE MINORITY

Mr. BINGHAM. Mr. Chairman, could I ask one more question?

Mr. ZABLOCKI. Yes.

Mr. BINGHAM. Mr. Jordan, I notice on the last page of your testimony you refer to the issue of the inclusion of riot control acts and heribicides in the prohibition of the Geneva protocol and you reiterate that the administration's position is that these are not covered by the protocol.

You are aware, of course, that we are in a very small minority among the nations. I think we are one of three nations that so interprets the protocol and as of now, at least, the question of this reservation has put an end to consideration of the ratification of the protocol because the Senate indicated it would not ratify on that basis.

My question is this: Are these not really fairly marginal matters as far as military strategy is concerned, particularly if one were to

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*For complete and accurate clarification it should be noted that the figures cited above by DOD and those noted in the testimony of Dr. Robinson on page 63 are not essentially comparable. The question to which the DOD figures respond referred to the fact that the United States has nerve agents in its current stockpile which were not in the stockpile at the close of World War II in 1945. In other words, the much higher lethality of the current stockpile nerve agents makes it possible to engage battlefield target areas with much smaller quantities of chemical agents. By contrast, the DOD figures for the inventory available at the close of World War II refer to the standard blister and choking gases. The elimination of these agents from our current stockpile and their replacement with nerve agents provides the United States with the capability to attack a much larger area than that provided by the inventory of CW agents in 1945. Thus, in terms of tons there has in fact been a reduction of almost 75 percent. However, in terms of capability, our current stockpiles have been calculated as providing a total battlefield target area that can be engaged effectively four times greater than that possible in 1945.

consider the possibility of a conflict of major importance with, let's say, the Soviet Union?

Are these not relatively marginal in their significance as far as military usefulness is concerned, riot control agents and herbicides?

Mr. JORDAN. In a full-fledged general war with the Soviet Union, one would have to suppose that these would be marginal factors. Of course, we have to contemplate an awful lot of other possible conflict situations.

I would hope that your committee, Mr. Bingham, and the entire membership of this body will use its influence with the other body to ratify the protocol.

MILITARY SIGNIFICANCE OF RCA'S AND HERBICIDES

We very much regret the attitude about the interpretation which has held up ratification by the other body. We have no question about the military significance of both RCA's and herbicides in a number of contexts, not of the kind you posited. As an example, we found many instances in Vietnam where we saved American and Allied lives in dealing with tunnels and bunkers.

I lost an ex-student and very close friend, one of the finest young men I knew, because he did not happen to have RCA's when he tried to clear a tunnel complex in which he knew there were women and children. He wound up getting himself shot while trying to take the complex without spraying the interior with his rifle. There were many instances of that kind that could be produced out of just the Vietnam conflict. So, in that context, there is no doubt about the effectiveness of RCA's. They have been very useful in the recovery of downed airmen, and there are other important uses such as their potential in protecting nuclear weapon sites.

We would be reluctant to give up this possibility in various conflict environments, even though its utility in an all-out conflict with the Soviet Union would be marginal. Herbicides are valuable in clearing foliage mine fields around a defensive perimeter where there are mines sown.

To help protect your defensive perimeter, you can't very well go in and mow the grass under such circumstances. If it is a choice between saving weeds and saving lives, I would rather save the defender's lives.

Mr. BINGHAM. Did the chairman have a question?

Mr. ZABLOCKI. No, I think the Secretary had clarified it, because I thought he had stated that he regretted that there was an interpretation.

Mr. BINGHAM. No, he regretted the action of the other body.

Mr. ZABLOCKI. Not the interpretation?

Mr. JORDAN. The action of the body.

Mr. ZABLOCKI. I regret both.

[Laughter.]

RUSSIAN RESERVATION ON FIRST USE

Mr. BINGHAM. We have had testimony here to the effect that ratification of the convention with a reservation of the kind that is involved here, particularly with respect to the riot control agents, might cause the Soviet Union, for example, to declare that that was not an effective

ratification and that, therefore, the treaty or the convention would not be binding as between itself and the United States.

Has that possibility been reviewed and considered?

Mr. JORDAN. A very large number of countries, including the Soviet Union, have reservations to their ratifications of the Geneva protocol. In fact, the Geneva protocol is faced with reservations from so many quarters that it is very difficult to sort out, short of a computer exercise, precisely what is in force with respect to the various parties. The step from RCA's to lethals is so disproportionate as to render such an argument moot.

Mr. BINGHAM. Could you tell us what the reservations of the Soviet Union are?

Mr. JORDAN. I would like to refer to counsel here for just a moment.

Mr. Forman of the General Counsel's Office of the Department of Defense.

Mr. FORMAN. It is my recollection, Mr. Bingham, that these reservations are set forth in full on page 271 in the 1969 hearings before this subcommittee. But briefly, the Russians' principal reservation is that they reserve the right to use chemical agents in the first instance against any belligerent party to the conflict who is not a party to the convention or who has an ally not a party which fails to respect the restrictions of the protocol.

Mr. JORDAN. Which is another reason we hope the other body will ratify it.

Mr. ZABLOCKI. With or without the reservation?

Mr. JORDAN. With the interpretations that we have stated.

Mr. BINGHAM. Thank you, Mr. Chairman.

Mr. ZABLOCKI. Mr. Wilson.

Mr. WILSON. No questions, Mr. Chairman.

UNLIKE BIOLOGICALS, CW HAS MILITARY SIGNIFICANCE

Mr. ZABLOCKI. Mr. Secretary, on page 8 of your prepared statement, you state:

> Unlike biologicals, chemical weapons are of military significance, have been used in this century, and could offer the initiator a significant tactical advantage. We, therefore, believe any chemical weapons limitations should have more effective verification provisions.

Would you care, very briefly, to advise this committee why chemical weapons are militarily more significant than biologicals?

Mr. JORDAN. The biological weapons are nontactical and are an unknown quantity. They have never been utilized, and their effects are not very clearly understood.

For one thing, they are indiscriminate and uncontrollable weapons. The disease which might be initiated by one of them might very well spread out, not only through the entire population of the area, but far beyond the local area.

They have not been applied in combat environment. Their actual military utility apart from their massive and indiscriminate effect is very speculative.

On the other hand, the behavior of chemical weapons is reasonably well understood and they have been used militarily and are capable of focusing on the tactical situation. They are tactical weapons that can be used to deny use of terrain and to deny movement, as well as to inflict casualties on combat and logistical troops.

DAMAGE OF HERBICIDES IN VIETNAM

Mr. ZABLOCKI. But regarding the use of chemical weapons in Vietnam, we were advised, that we still do not know what damage they have done to the environment. There was not only wild grass that was destroyed but it was used on food and rice, to deny the enemy the means of sustenance during the war.

In other words, there is an unknown factor surrounding the use of chemical weapons. If you use your argument as to the military significance of biologicals, you could also use that same argument for chemical weapons as well.

Mr. JORDAN. The military significance and military utility of herbicides were understood in the sense of their use in defoliating routes of communication, supply, or ambush sites by the enemy. These are not lethal chemicals.

It is true that there is some dispute about residual toxicity in the soil, but I understand that that residual effect is not as serious as had been feared in some quarters.

Mr. ZABLOCKI. There are very many knowledgeable people who differ with that interpretation.

ANALYSIS BY THE NATIONAL ACADEMY OF SCIENCES

Mr. JORDAN. I was drawing on the National Academy of Sciences report with regard to that, Mr. Chairman. There are other areas in which, obviously, there is room for differences of opinion with regard to these side effects of the herbicides.

But the utility of the weapons system in the military environment is what I was alluding to and I think that was well understood.

Mr. ZABLOCKI. Regarding your reference to the National Academy of Sciences, to what extent is that body consulted by the Department of Defense in this area?

Since you have quoted the National Academy of Science, are they in any way consulted, is their advice sought, when determinations are made by DOD as to the new weaponry in the chemical field?

Mr. JORDAN. This analysis by the National Academy of Sciences was an entirely independent appraisal, Mr. Chairman, of the effects of herbicides in Vietnam.

Mr. ZABLOCKI. Are their appraisals sought on other matters? For example, as DOD considers its posture, particularly in connection with the use of chemical warfare, is the Academy consulted?

Mr. JORDAN. Not routinely. I know that in this particular instance, this was a special case. The National Academy agreed to do a study on this particular question.

Apparently, my colleagues inform me, experts from the National Academy have advised the Department on the disposal of chemical weapons as well.

ACDA ROLE

Mr. ZABLOCKI. To what extent is the Arms Control and Disarmament Agency consulted on matters of this type, including when the binary systems were considered by DOD?

Mr. JORDAN. The Arms Control and Disarmament Agency and the Department of State, as parts of the National Security Council

machinery, are fully consulted. There is a full interagency study that I alluded to earlier currently underway, which will produce a restatement of U.S. chemical warfare policy.

On all significant decisions, for instance, a decision to produce binaries, the Arms Control and Disarmament Agency will have a full voice.

Mr. ZABLOCKI. Would you be in a position to advise us as to the view of ACDA at the present time on the advisability of entering into a binary system?

Mr. JORDAN. I would not. That is outside my province, Mr. Chairman.

NO VERIFICATION PROVISIONS IN BW CONVENTION

Mr. ZABLOCKI. In your statement on page 8, you say, "The verification provisions of the Biological Weapons Convention would be inadequate for a chemical weapons limitation agreement."

Would you care to amplify on that particular statement?

Mr. JORDAN. I will have to see if my colleagues have an accurate rendering of the verification provisions of the Biological Weapons Convention.

Our basic point here, I think, is that verification considerations did not really enter into our ratifying and undertaking the Biological Weapons Convention, because we had decided unilaterally to renounce them and dispose of our stocks.

So, the issue of verification measures was moot.

Mr. ZABLOCKI. Indeed, you do say that in the following sentence.

Mr. JORDAN. Yes.

Mr. ZABLOCKI. And what I was leading up to, if you would amplify on that first sentence. I had another question which had followed the sentence you referred to.

Mr. JORDAN. Yes.

I am told there are no specific verification provisions.

Mr. ZABLOCKI. There were no verification provisions in the Biological Convention?

Mr. JORDAN. That is correct.

CW—"FIRST USE" VERSUS "ALL USE"

Mr. ZABLOCKI. There were no verification provisions for biological weapons in the Biological Weapons Convention. Then if there were none how could you say they would be inadequate for a CW agreement?

Mr. JORDAN. My colleague Colonel Granger is very quickly spinning over the Biological Weapons Convention here. I think the point was, it was not a consideration.

Mr. ZABLOCKI. Let me go to the next question.

In your next sentence, in reference to the Biological Convention, you say this: "Reliable verification of other countries' actions regarding BW was deemed not possible, but verification procedures were not an important consideration." The point you seem to be making is that since we unilaterally renunciated biological weapons, verification was not regarded as an important problem. As I understand the executive branch's position, would not the same logic hold if we unilaterally renunciated chemical warfare?

Mr. JORDAN. What is involved is renunciation of first use in the Geneva protocol; whereas, it was renunciation of all use in the case of biological weapons.

We have entered a reservation on the Geneva protocol, that it applies to first use. That is U.S. policy.

We are talking about chemical warfare now. We have no reservation with respect to the biological weapons. We have a reservation to the affect that the protocol prohibits only first use and not second or retaliatory use.

Mr. ZABLOCKI. Mr. du Pont.

Mr. DU PONT. I haven't anything.

DIA BRIEFING "OFF THE RECORD"

Mr. ZABLOCKI. Are there any further questions?

The Chair would like to state we are in somewhat of a difficult position.

We would like to obtain some additional information that cannot be forthcoming in open session.

Mr. BINGHAM. Don't we have a quorum?

Mr. ZABLOCKI. Not unless you count me for two.

We need a majority.

Mr. JORDAN. If we could offer the briefing of the Defense Intelligence Agency off the record, we would be pleased to do that.

Mr. ZABLOCKI. If there are no further questions of the Secretary at this time in open session, the subcommittee session will close and stand adjourned until 2 p.m. on Tuesday, May 14, 1974, when our witnesses will be Mr. Leon Sloss, Deputy Director of Politico-Military Affairs, State Department, and Dr. Fred Ikle, Director, Arms Control and Disarmament Agency.

Those members desiring to remain for an informal briefing, not session, for the purpose of hearing the Defense Intelligence Agency briefing, will be welcome and the room will have to be cleared.

[Whereupon at 3:13 p.m., the subcommittee adjourned, to reconvene at 2 p.m., Tuesday, May 14, 1974.]

U.S. CHEMICAL WARFARE POLICY

TUESDAY, MAY 14, 1974

House of Representatives,
Committee on Foreign Affairs,
Subcommittee on National Security
Policy and Scientific Developments,
Washington, D.C.

The subcommittee met at 2:28 p.m., in room 2200, Rayburn House Office Building, Hon. Clement J. Zablocki (chairman of the subcommittee) presiding.

Mr. Zablocki. The subcommittee will please come to order.

At the outset I apologize for being late. In the absence of the full committee chairman the Speaker had a matter I had to handle and I was therefore detained. When I advised him I was to be at a 2 o'clock subcommittee meeting, he said, "Well, why aren't you there?"

Today marks the final scheduled session of hearings by the subcommittee on National Security Policy and Scientific Developments into U.S. chemical warfare policies.

We are pleased to have as our witnesses this afternoon two distinguished spokesmen from the executive branch. They are:

Dr. Fred Ikle, Director of the Arms Control and Disarmament Agency, and, the Honorable Leon Sloss, Deputy Director of Politico-Military Affairs, Department of State.

I note each has an assistant with them, which notes the importance of their testimony.

We will hear each of you gentlemen separately, and then address our questions to you as a team.

Dr. Ikle, if you will proceed first, please.

STATEMENT OF HON. FRED C. IKLE, DIRECTOR, ARMS CONTROL AND DISARMAMENT AGENCY

Mr. Ikle. Mr. Chairman, members of this committee, I am pleased to be here today to discuss control of chemical weapons. I want to commend the committee for its interest in this important subject.

Since the committee has now heard from a number of witnesses, I am certain you are familiar with the principal aspects of U.S. policy in the chemical weapons field and of our arms control activities in this area. Consequently, my prepared statement will be quite brief. To a large extent, the issues are separable and can, therefore, be examined on their individual merits.

33-749—74——12

U.S. RATIFICATION CRITICAL

Two major agreements dealing with chemical and biological weapons have been submitted to the Senate for its advice and consent to ratification. One, the Geneva protocol of 1925 prohibits, in effect, the first use of chemical and biological agents in war. Except for the United States, all militarily significant countries, including the Soviet Union and the People's Republic of China, are parties to the protocol. We hope that the current differences will be resolved and that the United States will become a party in the near future.

Second, the Biological Weapons Convention of 1972, which prohibits the development, production, stockpiling, acquisition, or retention of biological agents or toxins for other than peaceful purposes, is also before the Senate. In order for this treaty to come into force, it must be ratified by the three depositaries: The United States, United Kingdom, and the U.S.S.R., and at least 19 other countries. Enough countries have ratified so that only ratification by the depositaries is required, some 32. Now that the British have completed all the parliamentary requirements for ratification, and the Soviet Union has indicated that its ratification process is nearly complete, it is particularly important that U.S. ratification be accomplished in the near future so that this important agreement can enter into force.

JAPANESE PROPOSAL: PROHIBITION IN STAGES

Further restraints on chemical weapons are being discussed at the 26-nation Conference of the Committee on Disarmament, CCD, in Geneva. The goal of the United States can be stated very simply: The effective prohibition of chemical weapons.

At the present time there are two draft treaty proposals before the CCD. In March 1972, the Soviet Union and its allies put forth a draft convention for the complete prohibition of the development and production of chemical agents and munitions and for the destruction of CW stockpiles. In our view the Soviet draft treaty does not provide an acceptable basis for negotiation, particularly because of the inadequacy of its verification provisions.

Just a little over 2 weeks ago, the Japanese delegation presented a draft treaty at the CCD. This proposal calls for a complete prohibition to be reached in stages. Production of super-toxic CW agents, such as nerve gases, would be banned initially. We welcome the Japanese initiative as a serious and constructive effort to facilitate discussions at the CCD and we are giving the proposal careful study.

The gradual approach of the Japanese proposal relates the scope of activities to be prohibited to possibilities of verification. In our view, an appropriate relationship between scope and verification is an important feature for an effective limitation of chemical weapons.

HEARINGS HELPFUL IN RESOLVING DIFFERENCES

All of us who have responsibilities regarding the shaping of U.S. policy on chemical weapons limitations—in the executive as well as in the legislative branch—are agreed on the primary objective of this policy: Preventing the use of lethal chemical and bacteriological weapons. As to the best means to this end, there are differences of opinion.

Some of these differences are easily resolved; others require difficult judgments. We welcome these hearings, for they help us through this open process to arrive at better conclusions.

I would be pleased to try to answer any questions you may have on these or related subjects.

Mr. ZABLOCKI. Thank you, Doctor.

Mr. Sloss.

STATEMENT OF LEON SLOSS, DEPUTY DIRECTOR, POLITICO-MILITARY AFFAIRS, DEPARTMENT OF STATE

Mr. SLOSS. Mr. Chairman and gentlemen, I have submitted a statement for the record which I won't try to restate here. I want just briefly to restate for you the administration's views on four main issues: the Geneva Protocol of 1925; the Biological Warfare Convention of 1972; the discussion of chemical warfare restrictions at the CCD in Geneva; and binary chemical munitions.

ARMS CONTROL NOT AN END IN ITSELF

First, just a few words about arms control in general and chemical arms control in particular. As the President has stated, the administration is dedicated to moving from confrontation to negotiation. However, we don't look on arms control as an end in itself; it is one means to enhance our security.

The issues that have been raised before this committee involve close judgments or they would not be under debate here. If any and all controls on chemical weapons enhanced our security, and having chemical weapons unequivocally detracted from our security, the judgments would be easy. But this is not the case. Chemical weapons do have a deterrent effect, and we should control them or reduce them only if by doing so we can enhance our security. Some arms control agreements will enhance our security, and others will not. We are interested in real agreements, not just empty declarations.

In this area of chemical warfare, meaningful arms control measures involve determining whether the Nation's security is best served by entering into arms control arrangements which inevitably circumscribe the actions we can take in our own defense; or alternatively by preserving our freedom of action in order to deter use by others. In this equation one must also weigh the extent to which potential adversaries would be constrained by the agreement and the degree of certainty that we would have that such nations would actually abide by such an agreement. It would hardly serve our interests or international stability to enter into agreements if we could not be assured of their observance by others.

POSITION OF ADMINISTRATION ON RATIFICATION

Now as to the Geneva protocol, we want to see it ratified, and we are fully as committed as the Congress to doing so promptly. As you know, the main issues that are holding up ratification are differences over riot control agents and herbicides. These are honest differences.

I would just make three points which underlie the administration view.

First, the protocol is in our view ambiguous as to the coverage of riot control agents and herbicides.

Second, I would note that these agents are not lethal weapons, although their use certainly can have some undesirable effects. They have demonstrated some military utility. Their use has saved the lives of our troops and of noncombatants; thus giving up the right to use them in war has both pros and cons. In our view the best way that Congress can reinforce past U.S. policy initiatives in this area is by prompt ratification of the protocol.

Turning to the Biological Weapons Convention, again we favor prompt ratification by the Senate. We have already renounced production, use, and stockpiling of biological weapons. Early ratification would make the constraints on others equally binding as the ones that we have already undertaken. Failure to ratify on the other hand might leave the United States in the position of being the principal obstacle to the convention coming into force, thereby undermining the past favorable impact of our policy. The military utility and potential consequences of biological weapons use are such that we can accept uncertain restraints on potential adversaries in this area while we cannot in other fields.

U.S. POLICY ON CHEMICAL WARFARE MULTIFACETED

To turn briefly to the chemical arms control proposals at Geneva which Dr. Ikle has referred to, the aims of our chemical warfare policy are first to deter the use of chemical warfare by others; secondly, to negotiate verifiable restraints that will apply broadly to all or to most nations; and thirdly, to enhance the U.S. international image as a leader in developing practical arms control arrangements.

The United States has already renounced use of lethal chemicals as a matter of policy, and we have not produced any chemical munitions for some years. We have committed ourselves to further efforts toward arms control over chemical weapons by our acceptance of the Biological Warfare Convention, and at the CCD in Geneva. The main obstacle, as you know, is verification. Reliable verification of production and deployment limitations is extremely difficult, and verification is more important in chemical warfare than in biological warfare.

Our modest chemical stocks do serve a deterrent role. To fall back solely on the nuclear deterrent would in our view be very risky and most undesirable. Thus, if we are to accept limits we need to be sure that others will do the same. We are continuing our work on improving verification techniques both here in our own studies and in the discussions at Geneva.

PROS AND CONS OF THE BINARY

Finally, a few words about binary agents which have been a major subject of your discussions here. This is another of these close issues.

No decision has been reached to produce or not to produce binaries. On the one hand we acknowledge that to reopen CW production would have adverse political effects both at home and abroad. On the other hand, if we are to maintain CW deterrent stocks, binaries do have some advantages over present munitions. Thus we need to balance the desire to improve our stockpile with binaries against the potential political and arms control costs of doing so. The matter, as you have heard, is

under study, and I can assure you that all facets, including the political and the arms control, will be carefully examined.

In sum, we share the concerns and the aims of many of the witnesses before this committee who seek to restrict the use of chemical weapons, but we must be sure that any restraints will enhance rather than detract from our security.

I would also be more than happy to answer your questions.

[Mr. Sloss' prepared statement follows:]

STATEMENT OF LEON SLOSS, DEPUTY DIRECTOR, POLITICO-MILITARY AFFAIRS, DEPARTMENT OF STATE

I am indeed happy to have this opportunity to testify on behalf of the Department of State before this subcommittee about U.S. chemical warfare policy. Your inquiry is a timely one because important decisions face the U.S. Government with respect to chemical weapons programs and arms control agreements. In addition, your committee will by these hearings help inform the other Members of Congress and the public on these issues. I hope I can, today, contribute to that process.

To us in State there seem to be four basic issues for U.S. policy that arise in the chemical warfare context:

U.S. ratification of the 1925 Geneva protocol;

U.S. ratification of the Biological Weapons Convention of 1972;

The on-going discussion of further restrictions on chemical warfare at the Geneva Conference of the Committee on Disarmament (CCD);

The political implications of the proposed acquisition of binary chemical munitions by the Armed Forces.

First, let me say a few words in general about arms control. This administration is dedicated to moving, in the President's words, from an era of confrontation to one of negotiation. Our numerous efforts toward arms control—in chemical warfare as in other areas—reflect the sincerity of this dedication. However, one should always bear in mind that arms control is not an end in itself. Rather arms control agreements are an alternative means of safeguarding the Nation's security, broadly construed, at lower levels of cost or risk. The United States also must continue to maintain Armed Forces in order to protect our security. The size, character and equipment of those forces reflect a complex series of judgments about the requirements for deterrence and defense, taking into account arms control considerations as well as other factors.

Whether any specific arms control arrangements will serve overall U.S. security interests is seldom an easy judgment. When it comes to chemical weapons, for example, we would all feel more secure if they did not exist. But they do exist and I doubt that many of us would feel more secure if the United States were to do away with them unilaterally and others did not; or if we entered into arrangements which assured the dismantling of our capabilities, but did not assure parallel action by others. What the United States seeks in this area of chemical warfare are agreements that will assure effective international limitations that are equally applicable to all and in which we can have some confidence will be observed equally by all.

THE 1925 GENEVA PROTOCOL

The administration remains strongly committed to the prompt ratification of the 1925 Geneva protocol because by such action the Congress can help to reinforce prior U.S. initiatives to limit chemical and biological weapons. As you know, the protocol in effect bans the first use in war of "poisonous, asphyxiating or other gases and biological methods of warfare." As such, it is consonant with long-standing U.S. policy. In 1969 the President stated that the United States would not make the first use in war of lethal or incapacitating chemical agents. Moreover, he totally renounced the use and the capability to use biological weapons and toxins.

However, ratification of the protocol has been delayed by the differing positions taken by the administration and the Senate Foreign Relations Committee on the inclusion of riot control agents and chemical herbicides under the protocol. While we understand the views of the committee on the coverage of the protocol and we realize these views are shared by many others, I want to explain why the administration maintains that such agents are not included under the protocol.

First, we should be clear what we are talking about. Herbicides are essentially the type of chemicals that have important agricultural uses. Riot control agents are a type of agent such as tear gas that is widely used in this and other countries by police for crowd control. As with all weapons, their widespread misuse in warfare can have undesirable consequences. I do not want to minimize these, but I do want to point out they are not lethal agents. Second, the protocol itself is ambiguous on whether these chemicals are covered and some parties take the position that such agents are included while others feel this is not the case. Indeed, herbicides had not been used in warfare prior to 1925 when the protocol was drafted. Third, to include them under the protocol would involve renouncing the use of weapons in whose absence military commanders will in some circumstances have no alternative save the use of deadly force.

However, we recognize that there are substantial arguments on the other side of the question such as these presented in these hearings by several of the witnesses. We realize that the issues here are not clear-cut and thus we do have them under review in the executive branch. Rest assured, all arguments pro and con will certainly be considered in the continuing administration review of its position on the riot control agent and herbicide question. In particular, we want to finally put the United States on record formally in support of the protocol.

The Geneva protocol is a major landmark in the effort to control chemical and biological warfare and it is unfortunate that the United States, a signatory of the protocol in 1925, should be the last remaining major military power which has not ratified it. Thus, the administration continues to endorse the goal of prompt ratification of the protocol.

THE BIOLOGICAL WEAPONS CONVENTION (1972)

The Biological Weapons Convention (BWC) is a comprehensive means banning the development, production and stockpiling of bacteriological (biological) and toxin weapons, and providing in addition for the destruction of such weapons that already exist. The convention is consonant with current U.S. policy—indeed, we had unilaterally renounced the use of such weapons, ceased their production and begun destroying our stockpile prior to the treaty's inception. That destruction process is now complete and our major biological warfare facilities have been given over to peaceful uses.

The Senate Foreign Relations Committee has yet to hold hearings on the convention and it would certainly be unfortunate if the difference over the Geneva protocol should further delay progress on this measure.

Verification of the provisions of the BWC relies upon national means. Quite frankly such means give us only limited capability for assuring that the convention will be complied with. However, we concluded that widespread international adherence to the convention with its attendant political inhibitions against potential violators was in the U.S. interest despite these limitations. The military desirability of biological wepaons is, to say the least, questionable; they have not been used to any significant degree in modern times and there is good likelihood they will not be used given the uncertain effects on the user as well as the intended victim. Thus we concluded that the potentially uncontrollable consequences of their use as well as the improbability of such use, surely by the United States but also by others, were sufficient to justify a decision to enter into a treaty which relies on uncertain verification. I should stress, however, that this is a form of verification which will be adequate in very few other contexts.

The State Department hopes that the Senate will move expeditiously in ratifying the convention especially since the lack of ratification by the United States may become the only barrier to the convention coming into force:

DISCUSSIONS IN THE CCD

A major topic in the recent discussions of the Geneva Conference of the Committee on Disarmament (CCD) has been an effort to place further controls on chemical weapons. A comprehensive measure in this area would ban the development, testing, production, and stockpiling of such weapons and provide for the destruction of stockpiles of chemical weapons. More limited measures would ban only some of these activities.

The Japanese have introduced a new draft chemical warfare treaty into the CCD in recent weeks. At this time, we are according that draft careful study. Overall, the administration remains committed to the goal of achieving effective

restraints on chemical weapons, an obligation formally incorporated in the Biological Weapons Convention. However, we believe that partial measures should receive consideration in view of the very serious problems in verifying comprehensive restraints on chemical weapons.

We rely on our chemical stockpile to serve as a deterrent to the use of chemical weapons by others. We know that several countries, most notably the Soviet Union, maintain chemical warfare capabilities. Thus, to enter into any comprehensive agreement that would limit the United States without reasonable assurance that it would be observed by others would unduly jeopardize U.S. security.

Reliable verification in this area is extremely difficult. Under a production ban, for example, we would need assurance that other parties to the ban were not producing such agents. A comprehensive ban would require means to insure that other parties had actually destroyed the entirety of their stockpiles. Again this presents verification problems. Arriving at effective measures which are acceptable to other potential parties for such verification is extremely complex. Yet, inadequate measures could lead to significant ambiguities which could result in disputes and actually reduce, not increase, our security. That certainly is not the goal of arms control. Despite these difficulties, we are continuing to study the problem in an effort to find constructive solutions: and we continue both here and in Geneva to actively explore possible means for resolving the thorny verification problem and moving ahead in this area.

BINARY CHEMICAL MUNITIONS

The final issue which I would like to address briefly is that of binary chemical munitions. I will not attempt to repeat here all of the arguments for and against the development and production of binary munitions which you have heard in previous testimony. What I would like to focus on are the foreign policy aspects of this issue.

The first thing that we have to consider in assessing the foreign policy implications of this proposed program is the impact that it would have on the general environment for arms control negotiations and on the impressions abroad of U.S. arms control policies. Some argue that the production of binary chemicals would be inconsistent with present U.S. policy on chemical munitions. I want to be quite explicit as to what that policy is. In 1969, after the President's decision to maintain existing chemical stockpiles, it was determined that there would be no further production of lethal chemical weapons until binary munitions had been developed. We are now at the point of deciding whether or not to proceed with the manufacture of binary agents. Such a step would not be inconsistent with past U.S. policy in that this policy contemplated the maintenance of a stockpile of lethal chemical munitions for deterrent purposes. But our review will also include all aspects encompassing not only the military factors but also the idea that the U.S. binary program would be seen by many countries as a lack of interest by the United States in further arms control agreements regarding chemical weapons. However, as previously noted there will be considerable difficulty in developing effective restraints in this area and thus, if we need to improve our chemical warfare capability, the United States may not be able indefinitely to postpone a decision on producing these agents. In sum, there are various considerations which the Government will need to weigh over the next several months in arriving at a decision as to what is appropriate policy in this area. The foreign policy and arms control factors are important elements in this decision, and I can assure you that they will be given the weight which they deserve in our review.

OBSTACLES TO "EFFECTIVE PROHIBITION OF CHEMICAL WEAPONS"

Mr. ZABLOCKI. Thank you, Mr. Sloss.

Dr. Ikle, I would like to ask a very basic question. On page 2 of your prepared statement you say: "The goal of the United States can be stated very simply: The effective prohibition of chemical weapons."

This is our goal. Yet, how can we reach our goal when we don't ratify the 1925 Geneva protocol? How can we reach our goal if we continue in the binary program? In your opinion, will we ever reach our goal with the present policies we are following?

Mr. IKLE. At this time, Mr. Chairman, there are several obstacles to further movement toward that goal. One, the differences that have been mentioned in the past, and at the present time, delay the ratification process of the protocol. Another problem is the one referred to by Mr. Sloss, the problem of verification. If you want to go further than an agreement not to first use chemical weapons, but you actually ban production or eliminate stockpiles you have to make the calculation whether, without adequate verification, the military risk is acceptable. These are the difficult judgments to which Mr. Sloss referred.

NEED TO CLARIFY OBSTACLES TO VERIFICATION

As I said in my opening statement, I think these issues can be separated in this whole area, they need not all be entangled into one, and we can move with different speed and by different processes on each one of them, Mr. Chairman.

Mr. ZABLOCKI. Do you detect any speed on any one of them at the present time?

Mr. IKLE. There has been very slow development in the CCD; slow perhaps in our daily perspective, not so slow in the perspective of arms control developments which often take 5 or 10 years or more. This development in the CCD has been a steady clarification of the hurdles on verification. A clarification as represented in the Japanese draft, to which I referred, as to the important relationship between the scope of prohibition—whether a production ban, a ban on the most lethal agents, or other agents—and the scope of verification. A clarification is needed of the obstacles to a simple and satisfactory solution to the verification problem, given that production of chemical agents is intertwined with normal, peacetime chemical operations, and that in a closed society it is very hard to disentangle the two.

GENEVA PROTOCOL: 1922 TO 1970

Mr. ZABLOCKI. Do you believe that we should ratify the Geneva protocol of 1925 without exceptions?

Mr. IKLE. I would think we should not seek some legalistic perfection at the expense of this international understanding of arms control which really has stood the test of time. The determination to prohibit poison gas warfare goes back to World War I. It was our experience in the battlefields of World War I that led to this outrage and reaction against chemical warfare. And this country, the United States, took the principal initiative in bringing about the protocol of 1925.

Indeed, in 1922, at the Washington Naval Conference, the Washington Treaty on Submarines and Noxious Gases was drawn up and incorporated essentially the language of the Geneva protocol. That treaty was ratified or rather the U.S. Senate, when it was submitted, gave its advice and consent for ratification, without any dissenting vote. Thus, in 1922, the Senate accepted the essential language of the protocol.

Then in 1925, when that treaty did not go into effect—not because of our action but because France was unwilling to ratify that treaty—it was supplanted by the 1925 Geneva protocol that is still before us. As other witnesses have pointed out after 1925 there was opposition, in

part by the American Chemical Society, at that time to its ratification and, therefore, while it was reported out of the committee it was not submitted to the Senate floor for ratification.

Finally, some 20 years later, in 1947, it was returned to the administration, and then as you know it was resubmitted by President Nixon in 1970.

SCOPE OF THE PROTOCOL TODAY

Now, today the American Chemical Society supports ratification of the protocol. Indeed, now they argue that the scope of the protocol, or the interpretation, ought to be extended to cover herbicides and riot control agents. I think this long history is worth keeping in mind because we have here a large measure of international agreement and an important involvement of this country in this international agreement or understanding regarding first use of chemical weapons.

Mr. ZABLOCKI. Our previous witness, Prof. Richard Baxter of Harvard University Law School, noted that the Senate is a coequal body with the executive in our Government and they indeed could ratify the Geneva protocol of 1925 without the exceptions. After all, the exceptions were merely an interpretation of one man, the Secretary of State. Would you welcome such an action by the Senate? Would the Arms Control and Disarmament Agency's efforts toward bringing about negotiations in other areas be enhanced by such action on the part of the Senate?

Mr. IKLE. I have noted Professor Baxter's statement on this issue. He is a professor of law, and I am not.

Mr. ZABLOCKI. I am not a lawyer, either.

Mr. IKLE. The precise legal question involved here is the ratification process and reservation thereto. I am afraid I am not prepared to further elucidate, but the administration would certainly welcome the ratification of the protocol. I think this was made clear by its resubmission in 1970.

RATIFICATION: WITH OR WITHOUT RESERVATIONS?

Mr. ZABLOCKI. Obviously though, only with the exceptions.

Now my question to you, Would you welcome the ratification of the protocol with or without the exceptions?

Mr. IKLE. We would welcome generally a resolution of these differences. There are important considerations bearing on the reservations mentioned by Mr. Sloss, for instance. They touch on the question of these nonlethal agents. We face honest questions. The soldiers may ask: Is it better to use a flamethrower or tear gas in a certain situation?

These are not all such easy questions to answer. Is it better to kill weeds or to kill lives, on the question of herbicides? We have to look at the problem carefully.

Again, stressing the long history of the protocol, the very active role of the United States in its drafting, the fact that it was already ratified in earlier language by the U.S. Senate, I think that suggests a large measure of agreement on the question. The question is, How much time we should spend regarding the differences on the edges? Almost every international agreement has uncertain edges and boundary lines, and one can spend a long time trying to interpret and reinterpret this way or that.

WEIGHING ADVANTAGES AGAINST THE RISKS

Mr. ZABLOCKI. I know my time is over and I have many other questions, but just to follow up on what you have stated, Doctor. Certainly many questions arise, including the question that Mr. Sloss implies on page 2 of his prepared statement. I wonder if you agree with Mr. Sloss' characterization that "Arms control is not an end in itself."

Mr. IKLE. Certainly I agree with that. Arms control is a means to an end, enhancing our national security and world stability and world peace.

Mr. ZABLOCKI. But as I understand it Mr. Sloss, states that arms control is not an end in itself.

Mr. IKLE. I think I tried to recapture the meaning of that sentence as I understood Mr. Sloss.

Mr. ZABLOCKI. Maybe Mr. Sloss can elucidate on his statement so we can get a little excitement here.

Mr. SLOSS. Well, I think you are having trouble pitting us against each other on this issue.

Mr. ZABLOCKI. There are a couple others, but we will return to them later.

Mr. SLOSS. You may on others, sir.

I hold to that statement. I think the point that I tried to make in the longer statement, and also in my brief oral remarks, is that one has to weigh the overall advantages to our security which you gain through negotiated agreements against the risks entailed. This was not intended to be a negative statement on arms control.

MAINTAINING NATIONAL SECURITY

In some cases we are better served, I think, by avoiding unwise arms control agreements, and in particular where we cannot have assurance that others will comply with the agreement to the same extent that we will. So I don't think that we should look on arms control as an end in itself but as a means to a broader objective, which is the maintenance of our security at the minimum possible cost.

Mr. ZABLOCKI. Still no difference.

Mr. IKLE. I think the statute of my agency puts this quite well. It puts the arms control and disarmament efforts into the context of our overall national security efforts, in support of national security policy. We try to pursue, in whichever way seems promising, disarmament measures to enhance national security and prospects for world peace.

Mr. ZABLOCKI. My time is up. I will call on Mr. du Pont, who is a lawyer, an excellent lawyer, and a national lawyer. Perhaps he will pursue this.

DO WE NEED CW RESPONSE?

Mr. DU PONT. Thank you, Mr. Chairman.

My questions are going to be in another field entirely, and I will pass the questions on to Mr. Biester when his turn comes along, or Mr. Fraser, either one.

My question I think is for Mr. Sloss, and I would like to probe a little bit the question of whether we need a chemical warfare response. It seems to me that divides into two different questions: whether we need one psychologically, and which goes to the statements you make

on page 2. I doubt that many of us would feel more secure if the United States were to do away with chemical warfare agents unilaterally and others do not. That is kind of a psychological question. Do we sleep better knowing that we have a chemical warfare retaliatory capability?

The second part of the question is, Do we need chemical warfare response in fact, or is our conventional warfare response and our nuclear capability sufficient in fact to deal with a chemical warfare attack? Perhaps you would like to expand on those two questions.

Mr. SLOSS. Yes, Mr. du Pont. This is a question that has occurred throughout these hearings. Let me give you my view on the matter.

THE PHILOSOPHY OF DETERRENCE

The principal purpose for which we now maintain a stockpile of chemical weapons is a deterrent to an adversary's use of CF. Now this business of deterrence is a very complicated subject, and I don't want to go into a philosophical discussion of it, but deterrence is in many respects in the mind of the other fellow, and I think the question that one has to ask is whether he would be as deterred from the use of chemical weapons in the absence of the U.S. chemical capability.

Now there are some who argue that our ability to retaliate with conventional and nuclear weapons would serve that purpose equally well. It is hard to probe into the mind of the potential adversary, but if we were to unilaterally renounce chemical weapons I think that his calculation of what he might be able to get away with are at least going to have to be reviewed and might well be changed. We have to be concerned not only about the use of any particular type of weapons but about their threatened use and about our reactions to their threatened use.

If an enemy seeing us without chemical weapons threatens to use chemical weapons against us, and the issue was one which didn't seem particularly urgent or serious enough to call for the use of nuclear weapons, we might feel that we had to back down. Or he might miscalculate and feel that we were going to back down. So these are some of the calculations.

I realize that sounds very complicated. I would sum it up by saying that nobody could be confident about what the effect would be, but I think there is a significant risk that if we removed the chemical deterrent from our stockpile either unilaterally or without adequate assurances that others have done the same, and particularly if we were to fall back on the use of nuclear weapons which, as I said in my statement, I think would be a very risky business, we would be taking a serious risk—a serious risk that an opponent might miscalculate.

MAJOR DIFFERENCES BETWEEN BW AND CW

Mr. DU PONT. Let me just follow up on that. What risk did we take when we unilaterally renounced biological warfare?

Mr. SLOSS. I feel there is a considerable difference between biologicals and chemicals. The main difference being that biological weapons are much more uncertain in their use and in their effects. This is something that we went into in great detail during the studies in 1969 when we arrived at these conclusions. The user of biological weapons is much

more uncertain about the effects on his own forces and his own population of such use and, therefore, there is a considerable element of self-deterrence, if you will, in the use of biological weapons. The same does not apply to the same degree in the use of chemical weapons.

Furthermore the evidence is that some countries have stocked chemical weapons for some years; chemical weapons have occasionally been used in warfare, and while I would not argue that their use is highly likely, I think their use is more likely than we judged the use of biological weapons to be. We relied on a convention in which verification was uncertain, but we felt because of these factors that it was easier to do so in the case of biological agents than with chemical agents.

MOVING AHEAD WITH DEFENSIVE EFFORTS

Mr. DU PONT. One more question, and then I will turn to Mr. Ikle.

Can we have a credible chemical warfare offensive capability without having a credible warfare defense capability, which we obviously do not have today?

Mr. SLOSS. In my judgment we cannot. I think there are things that we need to do about our defensive capability as well.

Mr. DU PONT. So almost regardless of whether we went ahead with weapons such as the binary delivery system we probably ought to be going ahead with defensive efforts.

Mr. SLOSS. I fully concur in that.

Mr. DU PONT. Mr. Ikle, you were very exercised there when we were talking about nuclear deterrents.

UNDERLINING THE RISK OF ESCALATION

Mr. IKLE. Yes, Mr. du Pont, you guessed correctly. I was merely going to underline the point already made by Mr. Sloss. I have noticed in the very valuable and interesting testimony of a number of the witnesses before this committee allusions to the possibility of deterring chemical weapons by the threat of escalation to tactical nuclear weapons.

From an arms control point of view, there are very serious misgivings about this idea. To be sure, any military planner contemplating aggression into an area where there are tactical nuclear weapons would have to give very serious consideration to that, but we also have to keep a sense of proportion in all of this and compare chemical warfare with the dangers and uncertainties of nuclear war.

The dangers of chemical war really are quite insignificant by comparison. I think we would be doing arms control upside down if, in order to get rid of chemical weapons, the much lesser danger, we increased the risk of escalation to tactical nuclear weapons, the much greater danger. I merely wanted to underline this point.

EMPHASIS ON NUCLEAR ARMS CONTROL

Mr. DU PONT. Well, you would agree then that it is necessary to have a chemical response to a chemical attack if there is no adequate substitute?

Mr. IKLE. That is not the point that I have just been making. The point I have been making is that we should not rely on, or stress,

or emphasize escalation to tactical nuclear weapons as a response to the first use against us, or our allies, of chemical weapons. From that it does not follow that we need certain chemical weapons, or chemical weapons in general, to deter. That is the second question.

Of course we have to always keep in mind that any major war creates serious risks regarding nuclear weapons, particularly nuclear weapons in an area such as central Europe. Thus, there are many forces hopefully deterring war. That is what military effort is about, including our nuclear weapons.

The only thing I wanted to bring back into balance is the relatively much greater importance of nuclear arms control in our overall national security effort; that is to say, to prevent nuclear war and use of nuclear weapons as compared to the less important objective of preventing use of chemical weapons.

CHEMICAL WARFARE TO NUCLEAR NOT A CONTINUUM

Mr. DU PONT. Let me ask one more question, Mr. Chairman.

There is then in your mind some kind of a threshold here, and if we pass over that threshold in the use of nuclear weapons let's say in response to a chemical warfare attack we risk some much greater nuclear holocaust than we otherwise would by responding to the conventional force or by the response of the chemical?

Mr. IKLE. The point I wanted to make was that playing around with the idea of, or stressing the idea of nuclear escalation gets us into a very, very dangerous area. Now the tactical nuclear weapons and strategic nuclear weapons indeed play a very important role in our posture in Europe, as well as globally. But to say that if chemical weapons were used there is a simple answer through nuclear weapons, I think that is dangerous.

Mr. DU PONT. Thank you.

Thank you, Mr. Chairman.

Mr. ZABLOCKI. Mr. Fraser.

TESTING THE BINARY

Mr. FRASER. Thank you, Mr. Chairman.

Mr. Sloss, on the binary question my understanding from the testimony that we have had is that the administration has decided to seek money in the budget now before Congress to establish a binary production line. Is that your understanding?

Mr. SLOSS. That is correct.

Mr. FRASER. It is also my understanding that the Department has made no determination that the binary produced must be proven militarily effective, is that your understanding?

Mr. SLOSS. Yes.

Mr. FRASER. So you understand that the Department of Defense is now proceeding with the production facility and at this point has made no decision whether open air field testing is required or not, putting the two statements together.

Mr. SLOSS. They have requested funds for such a facility.

Mr. FRASER. That is right.

Mr. SLOSS. As far as I know there has not been any ground dug yet. The construction of the facility for which they requested funds has not yet begun.

Mr. FRASER. What is the purpose of testing of a weapon system?

Mr. SLOSS. Well, I am not an expert on the military effects but obviously the purpose in general is to see whether the system will work.

THE USE OF SIMULANTS IN TESTING

Mr. FRASER. Right. Now they say they have not decided whether they need such tests; right?

Mr. SLOSS. Open air tests; that is right.

Mr. FRASER. Right. In other words, they might decide that they need them.

Mr. SLOSS. As I understand it; yes.

Mr. FRASER. And the purpose then would be to find out whether it would work; is that right?

Mr. SLOSS. Right.

Mr. FRASER. And in the absence of that determination they are asking for the money to establish the production capability; is that right?

Mr. SLOSS. That is my understanding.

Mr. FRASER. Does that make sense?

Mr. SLOSS. I think it does make some sense because the point that you didn't cover in your question, and which I understand was covered by the Defense witnesses, is that you can conduct tests with simulated agents, and you can conduct laboratory tests. While this is not certain as yet, such tests may give you sufficient confidence to proceed with the production without having to conduct an open air test with the actual chemicals involved.

Mr. FRASER. Mr. Sloss, that does not quite deal with the question, because they have not taken that position, isn't that true?

Mr. SLOSS. They have taken the position that they may not need to have open air tests, but they have indicated that they can conduct certain tests with simulated chemicals which will give them some information about the utility of the system.

IS OPEN AIR TESTING REQUIRED?

Mr. FRASER. But I am now looking at the statement of Mr. Jordan.

Mr. SLOSS. Right.

Mr. FRASER. He says, "No determination has been made that open air testing will be required to prove military effectiveness."

Mr. SLOSS. That is right.

Mr. FRASER. I assume they may conclude that open-air testing is required to determine military open-air effectiveness.

Mr. SLOSS. Right.

Mr. FRASER. Yet, in the absence of that determination, in the absence of that test, they are asking Congress for the money to establish a production line, is that correct?

Mr. SLOSS. Yes.

Mr. FRASER. Does that make sense?

Mr. SLOSS. I think it makes sense in this way, if I may, Mr. Fraser. As I understand it, and really you should probe the Defense witnesses further on this, because I am not an expert on that aspect, but as I understand it these funds are to give them the capability to move ahead with the production facility and, therefore, they will have begun the

long leadtime items so that if it is determined that without a test it is feasible to move ahead with the production facility, they would be in a position to do that. As you know, it is many months before these funds will actually be available to them from appropriations, from the Congress, and it is the feeling in the Defense Department that they will buy some leadtime if it should prove feasible to go ahead in a few months from now.

THE QUESTION OF FUNDING

Mr. FRASER. All right. So what you are saying is that they are asking us for money to begin to put together a production line for a weapon system which they may determine needs to be field tested for military effectiveness.

Mr. SLOSS. Correct.

Mr. FRASER. And in any case presumably such testing may prove that the weapon system is not adequate.

Mr. SLOSS. That is quite so.

Mr. FRASER. In which case we may have wasted some or all of that money.

Mr. SLOSS. That is true if it is actually utilized for the beginning of production. Of course it is also possible that they could hold that money until the tests have been completed or until they find the tests are not necessary.

Mr. FRASER. You are familiar, generally, with our defense posture and the way in which we procure weapon systems.

Mr. SLOSS. Right.

PRODUCTION LINES FOR WEAPONS THAT ARE NOT ADEQUATELY TESTED

Mr. FRASER. Do you believe, in general, it is wise policy for our Government to proceed with putting together the production lines for a weapon system which has not been adequately tested?

Mr. SLOSS. I would not think it wise to go ahead with the actual expenditure of the funds, but sometimes it is necessary, and this does happen frequently in the Defense budget, to buy leadtime to have the funds available if it is determined that it is feasible to go ahead.

Mr. ZABLOCKI. Would the gentleman yield on that point?

Mr. FRASER. Yes.

Mr. ZABLOCKI. In prior testimony the gentleman may recall we were advised—perhaps you can confirm or deny it, Dr. Ikle—that U.S. policy on CW is under review, and that a decision may be forthcoming as early as 2 months from now, implying that perhaps the position of the executive branch may change either on the exceptions to the Geneva protocol of 1925 on the binary program. If this is the case then why go ahead with any expenditure for production at all?

Mr. Sloss, are you also aware of this serious review? I understand that the ACDA has had an input into this review. What is the status and the possible recommendations of that review, supposedly forthcoming in a month or two?

CANNOT FORECAST EXECUTIVE DECISION OF CW POLICY

Mr. SLOSS. I cannot begin to forecast what the recommendation might be, but let me describe a possible scenario which might help to

answer Mr. Fraser's question. This is not a prediction of what might happen. I don't know what the answer will be if and when it might come to a decision. I have no idea at the moment what the decision might be, but if, in the next several months, say in September of this year, if you had a decision to proceed with the production of binary munitions, and the Defense Department had not asked for this money, then they would have to wait until the next budget cycle to pick up the funds for the production facility.

If, on the other hand, you had a decision at that time not to proceed with binaries, nothing would have been done with these funds and they would clearly not be required. What I believe the Defense Department is doing is protecting themselves against a possible decision to proceed—protecting themselves against a delay should that decision be made in the next several months.

Mr. DU PONT. Will the gentleman yield?

Mr. FRASER. OK, if I could get a little more time.

PROS, CONS, ALTERNATIVES TO U.S. POSITION UNDER REVIEW

Mr. ZABLOCKI. If we could just have Dr. Ikle's comment on what the supposed new position might be.

Mr. IKLE. I certainly can confirm that chemical warfare policy has been under review. We have moved ahead looking at the pros and cons, and the various alternatives and hope to move to update the overall U.S. position. This is a fairly common process. We review U.S. Government policy on many issues all the time. We don't want to be locked into any particular policy on any issue, whether arms control or national security. We cannot, therefore, just for that reason stop production, or testing, or deployment of forces whose future status may be under review.

Also, it is fairly common for the military to want some standby production facility, on things which may not be produced. Whether expenditures on such facilities are wise depends, of course, on the amounts of money involved and the larger complex and risks, but as a matter of principle I am sure you could think of examples which are commonly accepted.

WILL THE BINARY REPLACE OR ENLARGE CW STOCKPILES?

Mr. FRASER. I want to go now to the objective in the proposed production of binary chemical weapon systems. We have been told by the Defense Department that "Our current stockpile of munitions"—and the reference there is to chemical munitions—"is limited and does not fully provide the capability we believe is necessary to adequately support all U.S. forces in case chemical war is used against us." Still quoting, "The composition of our present stockpile does not fully meet our requirements."

Does one properly infer from that statement that the binary production is intended not only to replace existing stockpiles but to enlarge them?

Mr. SLOSS. As far as I am concerned that is an open issue yet. I don't know whether they would be produced as replacements or additions, and indeed whether we would go ahead with the production of

binaries at all. I recognize that it is the Defense Department's judgment that they need more. I am not saying that I necessarily disagree with that judgment, but that is something that we are taking a look at in the ongoing studies.

NO IMPROVEMENT IN EFFECTIVENESS

Mr. FRASER. Is my understanding correct that the binary weapons, chemical weapons, when used in the combat situation are not any more effective than the present stockpile?

Mr. SLOSS. That is correct. They produce the same agents that we now have.

Mr. FRASER. That we already have in the stockpile?

Mr. SLOSS. Right.

Mr. FRASER. And it is now ready for use in combat, is that right?

Mr. SLOSS. Right, although a portion of the stockpile consists of agents stored in bulk.

Mr. FRASER. How long has the binary system been under development?

Mr. SLOSS. Oh, it has been under development for a number of years. I think about 10 years.

Mr. FRASER. Ten years.

Mr. SLOSS. It actually goes back to the 1950's when it first started.

THE ARGUMENT FOR EXPENDITURES

Mr. FRASER. Can you tell me what external exigency now requires us to fund a production line in the absence of a determination that the system has been adequately tested? What now causes us after 10 years of development to be in that position?

Mr. SLOSS. Well, let me first restate again that we have made no decision to go ahead with the production, so I have to be repetitive. I know I am sounding repetitive, but the argument for these expenditures is to hedge against a possible decision that has not yet been made that we might go ahead and produce it.

Mr. FRASER. Well, what is different about the fiscal 1975 year budget than say the fiscal 1974, or the fiscal 1973? Why now do we have to invest money in a production line for a weapon system that has not been tested?

Mr. SLOSS. I think the feasibility of producing the binary agent is now reasonably assured on the basis of the research that has already been done. That was not true 2 years ago. We now face a situation which we didn't have 2 or 3 years ago where the experts are reasonably confident that it is feasible to produce such a system, and therefore what was a theoretical possibility back in 1970 is now a firmer possibility.

BINARY NO LONGER A "GLEAM IN THE EYE"

Mr. FRASER. Well, but we could still have gone ahead with the production line in the belief that it would prove feasible, just as we are proposing to go ahead with the production line in the belief that testing either will prove the weapon system feasible or that we may decide it is not needed.

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Mr. SLOSS. True.

Mr. FRASER. Why are we doing this in fiscal 1975?

Mr. SLOSS. This is always a matter of judgment, of course, but it seems in fiscal 1975 that we are close enough to being able to produce an effective binary that it is not just a gleam in the eye any more, so that a decision might be made in the next few months.

Mr. FRASER. Well, based on your knowledge of our defense requirements, and keeping in mind your statement that the present stockpiles are as effective as the binary system, and that these are now in position for use in combat, and not on a first use but in a retaliatory posture, can you tell me whether in your judgment a delay of another year in the start of production of a binary system would be prejudicial to the security of the United States?

Mr. SLOSS. I really don't have a confident conclusion on that, Mr. Fraser. I am not trying to duck the question. I think that these are matters of close judgment.

OBLIGATION TO MAKE A DECISION

Mr. FRASER. Well, could you tell me the factors that would support why the security requirements would support going ahead in this fashion?

Mr. SLOSS. All right. Well, I think that essentially this decision needs to be made at some point in time. I think we have reached a point where we have a technological capability we are fairly confident of, so we are in the next few months reaching a decision point. At least it is our responsibility to take a look at that decision at the point where feasibility has been demonstrated. That does not say we have to make a decision this year, but I think at least we have an obligation to look at the problem and make a decision one way or the other because of technological factors.

Mr. FRASER. I am aware of the fact that once we discover something can be done there is a great impetus to do it, but from the point of view of the security of the United States, what are the reasons for going ahead in this fashion?

Mr. SLOSS. I am not making the argument incidentally that because you have the technology you ought to deploy it, but I do think it is responsible policymaking that, when you do have an option you should examine it and make a decision one way or the other. That is all that we are doing at the moment.

Now again, the reason for the money, of course, is that, if the decision should go favorably, then you have bought some time.

NATIONAL SECURITY NOT THE ISSUE

Mr. FRASER. You still have not told me what the national security requirement is for going ahead other than that it may be feasible to produce it.

Mr. SLOSS. Well, let me be clear on this point. As I think you have already been told by the Defense Department, the main advantages for binaries are logistic, management, and safety. As I pointed out earlier, the binary produces the same agent that you have now. So we are not arguing that we are going to have something better in the way of a

chemical capability. What we are arguing is that it might be easier to handle, easier to transport, easier to store than what we have now.

Mr. FRASER. Can I then take from your answer that you are not advancing any national security argument to do it now?

Mr. SLOSS. No, I would not say that.

Mr. FRASER. Let me just make the observation that you have not advanced any such argument.

Mr. SLOSS. All right. I will say that.

Mr. FRASER. Finally——

Mr. SLOSS. I would say, and if you can do something more efficiently and effectively, the same thing, that it seems to be a national security argument in a sense.

R.D.T & E. A PRECEDENT TO INVESTMENT

Mr. FRASER. Would you not believe that in the absence of a national security interest that an orderly progression of research and development and testing is a useful precedent to the investment of funds in a production line?

Mr. SLOSS. Yes, I would say that is the normal process.

Mr. FRASER. All right. I just have two or three questions and I will be through.

Mr. SLOSS. Let me add also that we certainly want to avoid open air testing if that is at all possible, so that pressure in the Government is going to be to find ways of avoiding that.

Mr. FRASER. I understand that, but what is clear is that that decision has not been made, that is what we have been told.

Mr. SLOSS. Correct.

Mr. FRASER. Now is this in any way, the going ahead of the production line, a bargaining chip?

Mr. SLOSS. I don't see it as a bargaining chip at all.

Mr. FRASER. So far as you know that has not been a factor in the consideration of moving ahead without testing the production capability?

Mr. SLOSS. No, not in my thinking it has not.

IMPACT OF "GO AHEAD" ON GENEVA NEGOTIATIONS

Mr. FRASER. All right. Now finally, if we go ahead with this new system and with a statement that on the face of it looks like we are going to enlarge our munitions stockpile—at least this is the testimony from the Department of Defense—in your view is this conducive to promotion of the negotiations at Geneva or what effect would it have?

Mr. SLOSS. Well, let me say first of all that as far as we are concerned in the State Department no decision has been made to expand the chemical stockpile, and we are not considering expansion of the chemical stockpile as a bargaining chip, if that is the import of your question.

I think that were we to make the decision to replace some existing stocks—and incidentally all that the Pentagon is talking about now is replacing a portion of the existing inventory with the binaries—it would be my judgment that this would have relatively little impact on our ability to achieve arms control agreement.

DOD POSITION

Mr. FRASER. The Defense Department statement says the current stockpile is limited, it does not fully provide the capability necessary. As a layman, that suggests to me that we are going to end up with something bigger and better than we have now.

Mr. SLOSS. They believe that the present stockpile is inadequate. Incidentally, much of that stockpile is in bulk and not in field munitions. In recent years, with the prospect of binaries, we have not been producing new chemical munitions. If I understand the Defense Department's position, it is that they would like to see more chemical munitions, they would also like to see binary munitions. I see that as two separate decisions, however. I think their testimony indicates that at least their initial plans are only to replace a portion of the stockpile with binaries.

Mr. FRASER. Thank you, Mr. Chairman.

PRODUCTION BAN LINKED TO VERIFICATION

Mr. ZABLOCKI. Well, I was just hoping to get Dr. Ikle's views on the proposed binary program. In recent testimony before another committee he stated, "If we start on a new type of production program it becomes even harder to envisage constructive arms control agreements limiting competition in the chemical weapons." Now Mr. Sloss apparently didn't think this would affect our negotiations.

Doctor, you clearly state that going into a new type of program—and the binary is such a new type of chemical program—would, in your opinion, present great difficulties in negotiating. Therefore, in response to the questions of Mr. Fraser, the committee would certainly welcome your views.

Mr. IKLE. Mr. Chairman, I think it is quite a simple issue that we are facing here. If we envisage, for example, a ban on the production of new chemical weapons, such as was mentioned as part of the Japanese proposals, then it follows logically that you cannot at the same time ban production and start production. These two would be contradictory.

A ban on production is desirable and for that reason we would not start production, but such a ban in part depends on our assessment of verification. I would not want to come before this committee, or any other committee, and argue we had a verifiable arms control agreement if we do not. At the same time, I would not want to come here and argue that just because there is some technology of violations whose production we cannot verify, we should go ahead and produce it. There are these two balancing problems.

DESIRABILITY OF RESEARCH

According to my statutory obligation, it is my duty to consider the arms control implications of our policies and also to advise Congress on arms control policies. I have come to the conclusion, as I have mentioned on previous occasions, that at this time we need not go ahead with new production of chemical weapons, binary or otherwise. This argument does not, however, affect the desirability or undesirability of research. We have many arms control agreements where we have to

continue research and development, in part, to enhance the viability of these agreements.

On the question of chemical weapons production we do not even have an agreement. All the more reason for our military, who are charged with the security of this country, from their point of view, to stay ahead and know what might arise from possible technological developments—hence research.

BUT NOT PRODUCTION

Mr. ZABLOCKI. But not production?

Mr. IKLE. At this time, to repeat myself, my personal judgment based on the arms control considerations which are the considerations I intend to bring forward and to represent, is that at this time, the pros and cons come out in favor of not going into production.

Mr. ZABLOCKI. Thank you, Doctor.

Mr. IKLE. But this is only one input, and I would be the first to admit there are military considerations, broader military considerations, considerations of logistics, which on balance may argue instead for going ahead with production. This determination, as Mr. Sloss mentioned, has not yet been made.

Mr. ZABLOCKI. I would assume that the State Department would be carefully studying and reviewing the effect on our relations with other countries of a U.S. decision to go into production on any new chemical warfare weapon. But I am sure future questions will bring that out, and I will not take the time now.

NSC FRAMEWORK

Mr. BIESTER. Thank you, Mr. Chairman.

I apologize to the Chair for being absent for a period of time.

I would like to nail down if I could what we just said, Doctor. Am I correct, therefore, that in your judgment on the standpoint of your official position that we should not go ahead with the binary system of production at this time?

Mr. IKLE. As I explained to the chairman, this is not an official position, it is a judgment based on the arms control considerations. I will be sitting down with my colleagues in the National Security Council framework to look at the various considerations—military, security, safety of our stockpiles, deterrence—and through our established processes the decision will be reached as to how these considerations, the arms control considerations which I mentioned and other considerations, cannot unbalance.

Mr. BIESTER. Your personal position is that it should not be put into production at this time?

Mr. IKLE. My personal judgment is that the arms control considerations argue against chemical arms production at this time.

JAPANESE INTERPRETATION

Mr. BIESTER. Mr. Sloss, is there any other country that interprets as the administration does the issue of herbicides and riot control agents in either the Geneva Convention or Protocol Convention of 1925?

Mr. SLOSS. Japan has interpreted the convention precisely as we propose to with respect to riot control agents (RCA's). Herbicides, as you know, and as I think the earlier testimony suggested, are in any event a less clear situation because herbicides were not mentioned back in 1925. The Japanese have taken the same position that we have on RCA, and they are among the most recent states to ratify the protocol.

Mr. BIESTER. Was there any other objections by any other signatory to the protocol raised when Japan announced that interpretation?

Mr. SLOSS. I do not know the answer to that question. I can certainly get it for you.

Mr. BIESTER. Well, for the record I would appreciate it.

Mr. SLOSS. Well, I will get that for you.

[The following was subsequently provided:]

To the best of our knowledge, no state party to the protocol has officially objected to the Japanese interpretation of that instrument.

MONEY FOR DEFENSE

Mr. BIESTER. If there is money going into the 1975 budget for production of the binary system, why is there no money for defense?

Mr. SLOSS. I believe that there is money for defense.

Mr. BIESTER. There is?

Mr. SLOSS. We will get that information for you from the Defense Department.

Mr. BIESTER. I would appreciate that.

Mr. SLOSS. I am fairly sure there is money in the DOD budget for defensive equipment.

[The information requested follows:]

DOD BUDGET FOR DEFENSIVE CW

According to figures provided to us by the Department of Defense, expenditures for R.D.T. & E. and procurement of chemical warfare defensive equipment totaled $25.8 million for fiscal year 1973, $24 million for fiscal year 1974 and a programed $33 million for fiscal year 1975. In addition, closely related expenditures for research on biological warfare defense of $10.4 million (fiscal year 1973), $12.6 million (fiscal year 1974), and $12.3 (programed for fiscal year 1975) should be added to the figures above. By contrast, R.D.T. & E. expenditures for lethal offensive CW for the 3 years in question were $5.7 million, $4.8 million and a programed $6.9 million. There has been no actual procurement of lethal CW munitions during the period.

TIME FACTOR IN DEFENSE AGAINST CW

Mr. BIESTER. Congressman Du Pont explored this issue of deterrence and retaliation, and I must confess, as he did, that it is a very difficult area in which to engage in prediction, but am I correct that with respect to chemical warfare that the capacity for adequate defense as long as one has notice of an impending application of chemical warfare is quite feasible in most instances?

Mr. SLOSS. Well, I would like to elaborate. As a general proposition it is true that there are means of defense. On the other hand, if you are the direct subject of an attack by nerve agents, there really is very little defense. If you are not immediately in the area where it is utilized, you have some time to protect yourself. If the dosage is not so heavy, then there are means of protection.

Mr. BIESTER. Such as clothing and gas masks and so forth?

Mr. SLOSS. Yes.

Mr. BIESTER. Our military forces are supplied, are they not, with adequate means of clothing defense and gas masks and so forth with respect to chemical warfare?

Mr. SLOSS. Yes, they are supplied with means. There is some difference of opinion as to how adequate that is.

Mr. BIESTER. Are you suggesting that it is not?

Mr. SLOSS. I would not want to give a military judgment on that, but my layman's impression is that it is less than adequate.

SPECIAL INTEREST IN ELIMINATING CW

Mr. BIESTER. Well, therefore, it would seem to me if we had a less than adequate defense for our military personnel with respect to chemical warfare in the field after all the money we have poured into trying to defend them that we have a special interest in seeing to it that chemical warfare is written out of the books in terms of conduct. It overrides the whole question of herbicides or RCA's, does it not?

Mr. SLOSS. I certainly agree with the latter point, and I agree with the former point. I think what is at issue here is what is the most effective means of assuring that chemical weapons won't be used.

Mr. BIESTER. I will get to that in a minute, but first I want to see where our forces are and in relation to these potential weapons. If you are suggesting that they are inadequately prepared for defense with respect to it, then there is a potential weapon usable against our forces as to which we do not have an adequate defense and, therefore, it seems to me that militates an aggressive push on our part to get that kind of warfare off the books and out of general military conduct.

DEVOTING RESOURCES TO DEFENSE

Mr. SLOSS. That certainly is one course of action, Mr. Biester. As I suggested earlier in responding to Mr. Du Pont, I think another course of action is to do more about defense. The problem of defense is not a technically insoluble problem, as I understand it, it is a matter of adequate resources being devoted to it.

Now obviously if we could be assured that the arms control arrangement could assure us against the use of chemical weapons this would be the preferable way to go, so we would not have to spend the money on the defensive equipment.

Mr. BIESTER. Or the offensive equipment.

Mr. SLOSS. Or the offensive equipment. But the question is whether we can find reliable means through arms control of assuring ourselves that chemical weapons will not be used.

OCCASIONING FIRST-USE

Mr. BIESTER. Now if a potential enemy had the same capability we had with respect to chemical warfare, and we knew that it was likely that our application of chemical warfare would produce a like-for-like retaliation, that it seems to me gives us condition A. Let us suppose, however, that we have a potential enemy that does not have capacity through chemical warfare, but does have capacity for tactical nuclear weapons, and it is not on our own part predictable whether he will or

will not use those tactical nuclear weapons in the event we apply chemical warfare, and let's call that condition B.

Which of the two is the more likely to produce a decision on our part to use chemical warfare?

Mr. SLOSS. Well, I would have to start by saying that neither of them is going to cause us to use chemical warfare first.

Mr. BIESTER. Let's use a potential enemy then. Which of those conditions is likely to occasion a potential enemy to apply first use of chemical warfare?

Mr. SLOSS. I don't want to give a complicated answer, but I think that depends on the issue at hand. He would be deterred by the prospective use of nuclear weapons if he thought the issue at hand warranted the use of nuclear weapons. But if he thought that it did not, he might not be deterred or he might feel that we would, as I said earlier, back down from the particular issue at hand before there was any need to use nuclear weapons. These are the problems that you have to at least deal with in answering such a question.

Mr. BIESTER. Thank you, Mr. Chairman.

Mr. ZABLOCKI. Mr. Bingham.

REQUESTING APPROVAL WITHOUT A "GO-AHEAD"

Mr. BINGHAM. Thank you, Mr. Chairman.

I must say I have found this a most interesting hearing.

Isn't it a most unusual procedure for the executive branch, before having reached a position on something, to come to the Congress and ask for the Congress to approve it, in effect, by authorizing or appropriating the money for it on the contingency that the executive branch may at some point decide that they may want to go ahead with it? I have never heard of that before. Have you?

Mr. IKLE. If I may answer that question. As I suggested before, it is really not all that unusual for a particular defense program to be under study regarding its desirability or undesirability while at the same time certain preparations are being made for moving ahead. We have this both in the strategic and conventional weapons area, and there are a great many defense programs which I would add, happily, are kept under review; we are not frozen into decisions.

Then, at the same time by necessity Congress had to be asked for funding of these programs, while the existing policy has not been revised or changed. Otherwise we would have to stop all these programs, or we would have to stop reviewing and studying them. I think it is good to have the two things going on together.

STANDBY PRODUCTION FACILITIES

Mr. BINGHAM. In that situation the Congress is asked to authorize research, but not production.

Mr. IKLE. Well, I think we could find parallels where Congress has been asked to provide a standby production facility while the plan to go ahead with large-scale production was still under review. Indeed, it is part of our general mobilization capability, a deterrent to the outbreak of war, according to which we keep a number of possible programs with standby production capability.

Mr. SLOSS. I was trying to think of an example, Mr. Bingham, while you were asking the question. I think we find this fairly frequently in our strategic weapons programs where there are long leadtime items where the research and development is still going on and the administration has asked the Congress to authorize a limited amount of funds for preproduction facilities, and preparation of long leadtime items. This does occur in the strategic missile area and complicated aircraft. It is not common, but it is not unheard of.

CONGRESSIONAL AUTHORIZATION WOULD STRENGTHEN PROPONENTS

Mr. BINGHAM. What really bothers me about it is that a decision by Congress to authorize these funds will certainly be interpreted, and I think fairly so, as a decision by Congress that this is what ought to be done. I can visualize that there is a battle going on in the executive branch. I have been in the executive branch, I know what these things are like. You are still in the middle of that battle, and yet somebody decided that rather than wait for the outcome of that battle in the executive branch you are going to ask Congress to go ahead, just so that the money will be there in case.

Now it seems very clear to me that that kind of decision by the Congress is going to strengthen the hands of those in the executive branch who are pressing for this program. They say, look, Congress has already approved it, Congress says it is OK.

And it will also be interpreted by other nations that we are dealing with as a decision by Congress that will be upsetting, I think, for the very reasons that you outline.

[Silence.]

Mr. ZABLOCKI. Which of the witnesses care to comment? [Laughter.]

APPROPRIATION REQUEST IS SMALL

Mr. IKLE. I might venture that, sir.

The amount of money that is being asked for here—$5.9 million—is, in the context of our defense expenditures, a small amount. It is not a full-scale or a large-scale production program. Maybe compared with the budget of my agency it is large; it is more than half of it! But I think the risk that you rightly fear, that congressional decision to authorize this initial standby production would be read, or misread, as a determination to go all the way on the production of binaries, is diminished by the fact that the amount of money is small.

Mr. ZABLOCKI. Well, I noticed both heads nodding while Mr. Bingham was presenting his scenario, but the answer thus far has not been in harmony with the nod agreeing with his scenario. [Laughter.] Mr. Sloss, maybe you could be more explicit.

Mr. SLOSS. I thought Mr. Bingham put the issue quite well.

Mr. ZABLOCKI. The question is, do you agree with him? [Laughter.]

MISINTERPRETATION VERSUS BENEFITS OF LEADTIME

Mr. SLOSS. I think he is right in saying that there is a risk that this will be misinterpreted. I think what the Congress will have to weigh, as we had to weigh, as we had to weigh in the executive branch, is what

are the risks that we would be giving an incorrect signal. Of course, this would mean a signal that we intended to proceed with the program and, of course, such risks could be minimized by what we say about it both in the Congress and the executive branch.

On the other hand, are there any benefits that would derive from providing this sort of leadtime which I have talked about. I am sure now that this is an issue which the appropriate committees will address. I just hope that they do address both sides of the issue. It appears to me that it is not a clear-cut one.

Let me put it this way. If our only concern was the potential signal that we would carry to other countries, that would make the decision relatively easy, but we do have to weigh all these factors.

SIGNALS FROM ABROAD

Mr. ZABLOCKI. Would the gentleman yield?

Apparently your antennas have been up at the State Department. What signals have you received thus far from abroad, from our allies as well as from our enemies?

Mr. BIESTER. And our adversaries.

Mr. ZABLOCKI. And our adversaries, as to what has been——

Mr. SLOSS. Well, the main thing is that there has been a good deal of interest in these hearings, and in the issues that have come out here.

Mr. ZABLOCKI. A little more meat. [Laughter.]

Mr. SLOSS. I have not seen any explicit expressions pro or con on the issue of binaries. I am sure that there are elements. I know that there are elements that are opposed to the production of binaries and would see it in the same way as do some in this country; that is, as a further expansion of our efforts in this area. There have been some expressions at Geneva of concern about the binary program, and in particular from some of the countries in the CCD at Geneva. Maybe Dr. Ikle could speak more explicitly to that, but we have not had any official bilateral representations, if that is what you mean, on this issue.

NO WORD FROM CCD

Mr. IKLE. If I may round out the picture, we have not heard from our negotiating partners in the CCD. There is a certain restlessness, that some of the Congressmen who visited the CCD last year or this year may have noticed, about the fact that no further progress has been made on chemical weapons, and in that context indeed the question of binaries has come up and has been raised by other countries.

Incidentally, to complete the picture, there also has been restlessness about the fact that we have not yet ratified the Biological Weapons Convention, and by the lack of our ratification we are preventing that international treaty from going into effect for the countries who have ratified, because of the provision that the three depositary nations must ratify, and the other two are willing to ratify, it seems. We are holding up for other countries an international treaty to which they have agreed. There is a long list of countries that are willing to have that go into effect.

Mr. ZABLOCKI. I didn't mean to impose upon your time.

Mr. BINGHAM. Not at all, Mr. Chairman.

Just one further comment on this, and it is a comment rather than a question. It also strikes us as curious that the administration decided to make this move now with the main question in effect unresolved, since I would suppose that this approach is more likely to receive a negative response from the Congress than an approach that was based on an agreed administration position.

SOVIET INTEREST IN ONSITE VERIFICATION

Let me move to some questions about verification. We had a report the other day that the Soviet Union representatives at the recent Pugwash Conference had indicated some new interest in onsite verification. Do you have anything on that, Dr. Ikle?

Mr. IKLE. I have further checked out that report, and while these exchanges in the so-called Pugwash Conferences are really very useful, the idea is that they should not reflect Government position.

The change in the Soviet views—in this case it would be private Soviet views—about verification possibilities, is not as strong as the witness suggested, but as often occurs in an informal conference, different participants have different impressions. It is like a meeting where three people report. They get three different reports.

WOULD THE BINARY INCREASE VERIFICATION DIFFICULTIES

Mr. BINGHAM. I am not sure whether this was touched on before, but would a binary system increase the difficulty of verification?

Mr. IKLE. The answer to that is not clear. There may be munitions required or production processes required that would leave the verification problem pretty much as it is for the current types of lethal chemical agents. Since transportation and stockpiling would become easier—and this is one of the reasons why binaries are favored by the military—maybe some of the activities surrounding transport and stockpiling would be less obvious and hence in that sense verification might become more difficult, but this is not the problem.

The problem is rather if you had an agreed ban on production, whether that could be verified.

JAPAN'S PROPOSAL

Mr. BINGHAM. Could you give us a little more on this Japanese proposal, the indication that because of the staged proposal for control by stages that that might make some sort of verification more practical? I don't quite understand that. Could you spell that out?

Mr. IKLE. The idea is to link a particular type of prohibition, such as prohibiting production of lethal agents only, or agreeing on abolishing stockpiles, to separate verification arrangements. For example, if you have certain forward deployment of chemical weapons requiring transportation, prohibiting international transportation may be easier to verify than prohibiting national stockpiles.

It says the problems of verification differ, depending on what is being limited or banned. And the Japanese draft tries to separate some of the steps that will be reached in the more distant future. It is a fairly elaborate and complex draft. If you like, we would be pleased to submit a brief description.

Mr. ZABLOCKI. That would be very helpful. Without objection it will be made a part of the record at this point.

[The information follows:]

DESCRIPTION OF JAPANESE DRAFT CONVENTION

The Japanese draft convention was submitted to the Conference of the Committee on Disarmament (CCD) on April 30, 1974. It establishes the objective of a prohibition of the development, production and stockpiling of chemical weapons and their destruction. This objective is to be reached in stages, beginning with a ban on organophosphorus nerve agents. Additional steps would be taken as further agreements, including those on effective verification measures, are reached.

The convention provides for the establishment of an International Verification Agency (IVA) and gives it a principal role in monitoring compliance by the states parties. The IVA would request explanations and conduct inquiries when necessary and it could initiate on-the-spot inspection, although it is not obligatory for states parties to accept inspection.

PARTIAL VS. COMPREHENSIVE VERIFICATION

Mr. BINGHAM. I take it from what you say that this Japanese proposal is being given careful study, and you regard it as you say as a serious constructive effort.

Mr. IKLE. That is right.

Mr. BINGHAM. Mr. Sloss, I think you spoke of partial measures in connection with verification. Did you have something similar in mind or what did you have in mind on that?

Mr. SLOSS. Well, generally we distinguish between a comprehensive agreement which would cover both stockpiling and production. A partial measure might just cover stocks rather than both the stockpiling and production. A partial measure might limit further stockpiling.

Mr. BINGHAM. In other words, that would be somewhat similar to the Japanese approach?

Mr. SLOSS. In some respects, yes.

Mr. BINGHAM. I think that is all.

Thank you, Mr. Chairman.

DIFFERING OPINIONS WITHIN THE EXECUTIVE

Mr. ZABLOCKI. The questions have been rather carefully phrased thus far. There was also some suggestion that differences of opinion exist in the executive branch. Allow me now to become a little more blunt. Mr. Sloss, I am sure you have read the transcript of our May 1 hearings, in which Representative Schroeder expressed the conviction that ACDA, and I quote, "Could press meaningfully ahead in the direction of international control of lethal chemical weapons if it had the support of its own State Department."

Now that we have got you here, Mr. Sloss, would you care to comment?

Mr. SLOSS. I am familiar with the statement.

Mr. IKLE. May I interject here, we do not own the State Department, Mr. Chairman.

Mr. ZABLOCKI. Well, I know you don't own the State Department. The question is, does the State Department own you? [Laughter.]

Mr. SLOSS. Mr. Chairman, we, of course, do have our differences at times over arms control issues. Sometimes I must say my boss, the Secretary of State, is well out in front and sometimes——

Mr. ZABLOCKI. On many occasions.

NSC A FORUM FOR RESOLUTION

Mr. SLOSS. Yes. I think that is fairly clear.

Ultimately these major issues are resolved through the National Security Council mechanism, and they go to the President for his decision. There are going to be different points of view about specific issues. Sometimes we are more conservative than ACDA on them, sometimes less so. I think you would all want these differences to be brought out in the process.

Mr. IKLE. May I interject? Because of the phrasing in the question of Congresswoman Schroeder, "ACDA's own State Department"—the possessive pronoun there. The statutory structure in which I operate is of course very clear. Particularly in the field of international arms control negotiations, the Director of the Arms Control Agency operates under the direction of the Secretary of State, and this is as it should be. The Director also gives advice to the President and the Secretary of State on arms control policies.

It is precisely this process, in which different agencies bring to bear a different point of view, that is more likely to lead to a prudent decision. I think it is hearings like this one where this open process can be extended to bring in the views of Members of Congress, so that we can further improve on the decisions that we take in our Government. It is important not to turn this desire for openness around and to bring into it the impression of conflict when we really are searching for right decisions, in a joint effort.

LACK OF PROGRESS AT GENEVA

Mr. ZABLOCKI. My comment was also in a facetious vein. However, in the previous testimony, Mrs. Schroeder also has stated that the current atmosphere at the CCD in Geneva is one, and I quote, "Heavy with pessimism" because of the U.S. failure to offer a meaningful negotiating position. Dr. Ikle, is that a fair appraisal?

Mr. IKLE. Congresswoman Schroeder has visited that Conference; other Members have visited it; I have visited it. We get almost daily or weekly reports from it, and unfortunately, the atmosphere is one of discouragement because no progress has been made. And the main topics happen to be the ones which this Conference has been discussing now for 2 years: One, the possibilities for agreed limitation on chemical weapons, and the other, the possibilities for extending the test ban on nuclear weapons.

U.S. POSITION NOT TABLED

Mr. ZABLOCKI. In that same connection, is it possible that the very existence of CCD may be threatened unless the U.S. Government proposes a draft treaty soon? I might ask why has not the United States tabled their position at CCD?

Mr. IKLE. I would doubt that the existence of this Conference is threatened by the fact that progress on chemical weapons has been so difficult. We do have, as I said, a very interesting draft by the Japanese. This Conference gives a number of other nations an opportunity to take an initiative in the arms control field, and we try to learn from them new ideas for making progress.

Why have we not tabled a U.S. proposal? Because of the problem of verification. If we cannot ourselves see a solution to verification, given consideration of this with other countries, there is no point in pretending, we have, therefore, tried to encourage debate on new approaches to verification. This we have done in that Conference.

Mr. ZABLOCKI. On the matter of verification, when specifically asked whether the binary program would complicate verification, the response of our DOD witness, Mr. Jordan, was a flat "no."

Mr. IKLE. I think I commented on that question earlier when it was asked, and I certainly would not see any reason for arguing that verification would become more difficult because of binaries.

DEVELOPMENT OF THE JAPANESE PROPOSAL

Mr. ZABLOCKI. I am clear on that point. I am not sure that this may be the proper forum to ask the question, but when I served as a congressional representative in the General Assembly of the United Nations proposals were often tabled by another country which were in fact of our making or developed with our assistance. Repeatedly reference is made to the Japanese proposal. I am curious whether we had a hand in that one. Is it ours in any respect, shape, form, manner?

Mr. IKLE. It is a proposal of the Japanese Government presented by the Japanese delegate, which we have carefully studied.

Mr. ZABLOCKI. Did we have prior consultation?

Mr. IKLE. Let me say it was probably shaped by the discussion with and is responsive to what our delegate, as well as other members of that Conference, has been voicing. Since the delegates of the participating countries have been in contact for such a long time, they are fully cognizant of the views of the governments of the other parties to the Conference, and in that sense the Japanese proposal, as well as other suggestions made by other countries in that Conference, are responsive to our position and to the points of view of other countries.

SEARCHING FOR A VERIFICATION FORMULA

Mr. SLOSS. Mr. Chairman, if I could just add a word. It is true that there is a certain degree of pessimism at the CCD. However, I think it would be most unfortunate if the contributions of countries to the CCD were measured in the terms of numbers of treaties they put on the table. It should not become a forum in which you are seeking credit for initiatives unless they are sound initiatives. The Soviet Union or some of their colleagues put a proposal on the table for which they got some credit simply because it was a piece of paper, but we find it very inadequate in terms of the verification aspects.

What we are seeking to do at this point is to find a sensible formula for verification. As I said in my earlier statement, verification is difficult but we are seeking to formulate an approach to it before we put a

piece of paper on the table. We are not going to put one down just for the sake of matching somebody else. That would be a rather trivial approach.

Mr. ZABLOCKI. That is also sometimes done here in the legislative branch.

FOREIGN POLICY ASPECTS OF THE BINARY

Mr. SLOSS, in regard to the binary program, you say on page 8 that you wish to focus on the foreign policy aspects of the issue. As you know, much of the alleged value of the binary as a deterrent relates to its availability in forward deployment areas. Representative Schroeder suggested that our NATO allies, Germany in particular, are less than enthusiastic over accepting the new binaries in stockpiles held there. The Department of Defense has suggested otherwise.

Now we are in a bit of a quandary. Can you clarify that situation, please? How do our allies feel about binaries?

Mr. SLOSS. This is a somewhat sensitive subject with the allies, and I don't want to characterize the views of other countries, at least in an open session. I will say this though, it is our judgment in the Department of State at this time that any effort to expand the size of our stockpile overseas or to increase the number of sites at which we have chemical weapons deployed would run into very serious political difficulties, diplomatic difficulties, if you will.

Mr. ZABLOCKI. Are we to assume that your answer would be they have no objection to the binary system?

Mr. SLOSS. No, I didn't mean to say that.

Mr. ZABLOCKI. It appeared that way to me. You said as long as we maintained the size of the present stockpiles there would be no objection. Yet, the logical conclusion would be to replace the present chemical weapons with binary weapons.

Mr. SLOSS. No, I don't want to leave that impression, but to go into allied views in any detail I really would want to go into executive session.

ALLIES UNENTHUSIASTIC ABOUT INCREASES IN STOCKPILES

Mr. ZABLOCKI. The purpose of these hearings—after all this subcommittee particularly is concerned with our foreign relations with our allies and adversaries, and what problems internationally they may cause. We are not particularly concerned with the military aspect itself. We are a Foreign Affairs Committee. We want to prevent problems. I would hope that we could get some meaningful answer on the question.

Mr. SLOSS. Let me restate what I said. I am not in the position to offer a judgment on whether the introduction of binaries would be accepted or resisted by our allies. I think there is some uncertainty of that, but I think it is clear that if we were to attempt to increase the stockpile or to increase the number of sites where we had weapons stockpiled that this would run into difficulties.

Mr. ZABLOCKI. I come to the same conclusion. In other words, the binary system is introduced, if the amount were the same, there may be trouble, but not necessarily.

Mr. SLOSS. That is right, we are uncertain on that. We cannot say that there would necessarily be trouble. We cannot say that it would be greeted with enthusiasm.

Mr. ZABLOCKI. That sheds a little light on the subject. There would not be any enthusiasm. In other words, they really don't want to.

Mr. SLOSS. But I could not say for sure that just the replacement of stocks would run into the kinds of problems that an expansion of the stockpile would.

Mr. BIESTER. Would the chairman yield?

Mr. ZABLOCKI. Yes.

RATIONALE OF THE BINARY SYSTEM

Mr. BIESTER. As I understand, the rationale of the binary system is that by stockpiling in areas that are not near to other materials which are neutral unless combined, we avoid the public apprehension involved in the whole problem of stockpiling. Now would that not be the case in Western Europe as well?

In other words, just going on a one-to-one basis from our current stockpiles in the binary, would that not create a better climate for the systems in Western Europe than we currently have, or am I just totally off?

Mr. SLOSS. That would be a logical conclusion. However, as you are well aware, there is a certain amount of emotion that surrounds these types of munitions and, therefore, I would not want to say with confidence that even though logically there is a strong case that these would be safer, I would not want to say that they just would be accepted without any difficulties.

INTERNATIONAL LAW AND "FIRST USE"

Mr. FRASER. Mr. Chairman, may I ask a question?

Mr. ZABLOCKI. Yes.

Mr. FRASER. U.S. forces assigned to NATO represent a small fraction of the NATO forces in Europe, am I right about that?

Mr. SLOSS. Correct.

Mr. FRASER. I have forgotten the percentage.

Mr. SLOSS. Ground forces around 25 percent in the central European theater, excluding France.

Mr. FRASER. About 25 percent.

Mr. SLOSS. Yes, about 25 percent.

Mr. FRASER. The other members of NATO, at least in the central European area, are all signers of the 1925 protocol, is that right?

Mr. SLOSS. That is right.

Mr. FRASER. And so is the Soviet Union?

Mr. IKLE. They have all ratified.

Mr. FRASER. They have all completed the process, so it is now in effect between them and the Soviet Union.

Mr. SLOSS. As between each other.

Mr. FRASER. That is the point I want to get to. As long as the United States fails to ratify, am I correct that if we got into hostilities with the Soviet Union that it would be legal under international law for them to make a first use of chemical warfare weapons against the U.S. forces?

Mr. SLOSS. The question has to do with allies. They are bound as against the other parties to the treaty.

Mr. FRASER. I understand, but as far as U.S. forces are concerned, in the absence of our ratification of the 1925 protocol, under international law, it would be legal for the Soviet Union to use chemical weapons against the U.S. forces?

Mr. SLOSS. That is correct, and they have taken a reservation to the protocol to that effect, didn't they?

Mr. BIESTER. It is in their reservation.

SOVIET RESERVATION TO THE PROTOCOL

Mr. SLOSS. They have taken a reservation which says it does not apply as to certain states. It does not apply to states who were nonparties.

Mr. MALONE. That is correct, Mr. Fraser. They have taken such a reservation, so that under those circumstances the provisions of the protocol would not apply. Now that is aside from the question of the restrictions that might be placed upon them by customary international law. To the extent that there is a rule of customary international law, which many argue that there is, they would be precluded from this, but under the protocol the reservation would apply to use against U.S. forces.

Mr. FRASER. So that so far as our allies are concerned in relation to the protocol, the continued presence of U.S. forces in Europe, the United States having failed to ratify the protocol, in a sense, puts at risk the whole issue of chemical warfare, since it would be permissible, so far as the protocol is concerned, to use such weapons against the U.S. forces in central Europe.

Mr. MALONE. In the sense that you are suggesting it, yes. I would suggest, however, that the customary international law aspect would come in and have an effect there.

CW EXTRANEOUS TO U.S. MILITARY

Mr. FRASER. Mr. Chairman, I have two other questions.

One of the witnesses made the point that the U.S. military generally does not like or accommodate to the use of chemical weapons; that is, that this tends to be a somewhat extraneous element in their routine and their training and their anticipations. Is that a reasonably accurate statement about U.S. forces?

Mr. IKLE. The question came up as to whether our defensive capability is adequate. I think a statement by General Abrams has been quoted where he himself argues that we ought to do more on the defensive side. Having discussed this with military experts we learn that defensive preparations are often considered an encumbrance, a nuisance, hence there may be a natural reluctance among all the military to do more on the defensive efforts. This attitude may have played a role.

Mr. FRASER. The Soviets, however, seem to have integrated a prospect of chemical warfare more clearly into their military planning, their equipment design, and their training in general readiness, isn't that true? Isn't that one of the things we learned from the last war in the Middle East?

Mr. IKLE. Yes, I would say so.

33-749—74——14

RESERVATIONS—A LEGAL QUESTION

Mr. FRASER. If there should be a ratification by the United States, the question of the desirability of riot control or herbicides does not bear directly on the legal question of whether they are embraced by the 1925 protocol. That is a fair conclusion, isn't it?

Mr. IKLE. The desirability is a separate question from the question whether they cover it.

Mr. FRASER. In the U.N. General Assembly vote there were how many votes that supported our position that they were not included?

Mr. IKLE. Only two votes.

Mr. SLOSS. Three, counting ours.

Mr. IKLE. Two supporting our position.

Mr. SLOSS. Thirty-six abstained.*

EXPECTATION OF NUCLEAR RETALIATION

Mr. FRASER. Finally, if there were a ratification of the protocol, and taking it a step further, if there were a failure on the part of the United States to use chemical warfare as a retaliatory or as a deterrent element in our posture, from an enemy point of view—this goes back to Mr. Biester's question—that enemy's introduction of chemical warfare into hostilities against the U.S. forces, No. 1, might be in violation of their international obligations, but, No. 2, knowing that we had no retaliatory capability in kind, would that not lead them to a much greater expectation that we might counter with tactical weapons, nuclear weapons. Isn't that a fair conclusion?

Mr. IKLE. I think you have heard me remark on that notion before. Any major war, and particularly in Central Europe, would raise the risk of nuclear weapons being used. Obviously, this is part of our deterrent posture—nuclear weapons. Whether one can say then that it follows that any use of chemical weapons anywhere in the world can easily be deterred by us relying on tactical nuclear weapons, is a different proposition with which, as I tried to elaborate earlier, I would not agree.

A LOGICAL SEQUENCE?

Mr. FRASER. I just want to make the point that the first step would be our ratification of the protocol, which would then bar first use and, therefore, be binding on other contracting parties as to their use of it against us.

Now the second element I want to add, if they knew that we did not even intend to have the chemical weapons, would that not increase their anticipation that we would likely respond with tactical nuclear weapons just as a practical matter?

Mr. IKLE. I think this would follow, but not necessarily.

Mr. FRASER. I am not suggesting that we would necessarily use them in any given circumstance, but they would find us much more ready to use them if it were clear and we didn't purport to have a chemical retaliatory capability.

Mr. SLOSS. I think there are two points to be made there. One is that they might consider us more willing to use them. Also the point

*The voting record on the U.N. Resolution of 1969 appears in the appendix on p. 372.

I was trying to make earlier, they might consider us more inclined to back down on whatever the issue was because that was our only choice.

The important point is the whole thrust of our policy over the last decade has been to try to raise the nuclear threshold rather than to lower it. The question is, would it be desirable in terms of that policy to put us in a position where that was our only choice?

Mr. FRASER. Your statement I think is partly true, but it obviously cannot be completely true or we would not be designing small tactical nuclear weapons. That increases the range of uses and, therefore, lowers the threshold.

Mr. SLOSS. Well, I would not agree with you necessarily on that point.

Mr. FRASER. If you take that technological development alone, it would seem to me it clearly lowers the threshold. Now there may be other circumstances.

Mr. SLOSS. Also what we have been doing is to build up the conventional forces in Europe which has a strong tendency to push us in the other direction.

Mr. FRASER. Thank you.

THE LEVELS OF DECISION

Mr. ZABLOCKI. Perhaps this question should have been asked at the very beginning and it probably should be directed to both of you. On page 2 of your testimony, Mr. Sloss, you speak of U.S. arms control policy on chemical warfare and other areas being the result of a "complex series of judgments" about the requirements for deterrence and defense. You directly say, "The size, character and equipment of those forces reflect a complex series of judgments about the requirements for deterrence and defense, taking into account arms control considerations as well as other factors."

Now just who makes those judgments? The National Security Council? The President? Who, for example, made the final decision to proceed on the binary program?

Have both witnesses a reply to that?

Mr. SLOSS. The level of decision, of course, depends on the level of the issue. There is both through the National Security Council and through the budget process, an interagency mechanism. While it can't bring every item in the Defense budget to the President, it brings the major decisions before him. Other decisions are made in the NSC mechanism, or in the OMB, or in the Defense Department itself.

FOREIGN POLICY IMPACT OF DEFENSE BUDGET

We in the State Department, particularly in our Bureau of Politico/Military Affairs, very closely monitor the development of the Defense budget. We try to identify issues that are going to have a foreign policy impact on arms control, as that budget is developed, and we then have an opportunity to voice our views whether at the staff level or through the Secretary of State, depending again on the importance of the issue.

Mr. ZABLOCKI. Doctor Ikle.

Mr. IKLE. I think this description by Mr. Sloss is an accurate description to which I can add very little, except to point out that the study

that has been referred to on the overall arms control and national security policy regarding chemical weapons would be handled in the so-called Verification Panel, and depending on the level of issues it might be referred to the National Security Council.

In the last analysis, of course, the President would make the decision. Smaller issues might be settled in discussions in the Verification Panel.

PROTOCOL INTERPRETATION APPROVED BY PRESIDENT

Mr. ZABLOCKI. Well, on that note of agreement between the two witnesses perhaps we can obtain the answer from both as to the question of herbicides and tear gas now under review. How important is the issue, and at what level is it now being considered? As you stated, depending on the importance of the issue, it would either be at the National Security level or by the OMB. Where is it now?

Mr. SLOSS. The initial decision to submit the protocol to the Senate with the current interpretation was approved by the President. There are constant reviews of these matters which take place within the NSC system. Should there be any decision made to change that position, it would almost certainly be made by the President.

Mr. MALONE. Mr. Chairman, if I may be heard for just a moment, I believe Mr. Sloss used the term "the original decision to submit the protocol with the reservation." I do not believe that the submission covering what I believe you were referring to, chemical herbicides and the riot control agents, was suggested as a reservation, it was suggested as an understanding. We did suggest at the time that the administration submitted the documents in 1970 that there be a reservation, but that did not go to the question of riot control agents and chemical herbicides, that was merely an understanding.

Mr. ZABLOCKI. Let the record show that was Mr. James L. Malone, General Counsel of ACDA.

I appreciate the clarification.

THE IMPORTANCE OF RATIFICATION

Mr. ZABLOCKI. This understanding is now under review?

Mr. IKLE. That is correct.

Mr. ZABLOCKI. Would you classify it as an important issue?

Mr. IKLE. I say a decision that can advance the ratification of the Geneva protocol and the Biological Weapons Convention is indeed an important issue. Particulaly the latter—the fact that the Biological Weapons Convention has not been ratified, is a serious matter. We have stopped producing any biological weapons agents. More than that, we have dismantled the facilities and, therefore, are somewhat naked without the protection of this convention, at least in the legal sense.

Mr. ZABLOCKI. On a facetious note the chairman observes the reference to "somewhat naked." We are not streaking?

Mr. IKLE. Not here.

AN END TO THE REVIEW—HOW SOON?

Mr. ZABLOCKI. Could we have sort of a closing prediction as to how soon can we expect the review to end, which will be another way of saying how soon can we expect some report on the question of herbicides and tear gas?

Mr. IKLE. I am not sure there would be much to report. I think the essence is really what is at stake here. There is a universal agreement that the protocol covers lethal agents. There is disagreement on these fringe areas. Disagreement on fringe areas can often last for a long time. I think I sketched in earlier the history where in 1922 the Senate approved language similar to the protocol of 1925, which the Senate has not yet ratified. Our concern is to bring about ratification. Whether all these legal questions will ever be resolved is uncertain. I don't think that is an important issue.

Mr. ZABLOCKI. From past experience how long does it take to make a judgment on an important issue?

Mr. IKLE. I think by this process, which is an onging one, new information often comes in and a new decision is made.

FORMALIZING THE AGREEMENT

Mr. ZABLOCKI. How long did it take the President to make the decision on the worldwide alert?

Mr. IKLE. Some decisions, Mr. Chairman, as your example suggests, have to be done very quickly in the national security interest. Happily we have more time for other decisions and, more important, we have an open mind and can review decisions in many areas.

Now I am worried, if I may speak out here at this point, that on these two conventions, the protocol and the Biological Weapons Convention, that opinion might change again. We have a large measure of agreement now. The field of biology does not stand still; new developments may occur in microbiology, and my successor may be here 5 or 10 years hence, and the debate may be about some new biological weapon, whether it should be produced or not, or the production facility funded or not, if we cannot move ahead to formalize this agreement that now exists regarding biological weapons and regarding the no-first use of lethal chemical agents.

Mr. ZABLOCKI. Any further questions?

CONCLUSION

Mr. BINGHAM. Yes, Mr. Chairman. Just one point. I would like to perhaps clarify something I said before.

I don't think you should get the impression from what I said that it is a bad idea for the administration to come to the Congress with some of these issues before there is a resolution; actually we prefer it that way. We get more help in our consideration of the matter if we are getting different points of view presented rather than a monolithic

point of view, but I did say that it seemed unusual that it would be a request for funds at that stage. I welcome the fact that you present varying points of view.

Thank you.

Mr. ZABLOCKI. I certainly want to observe there was a generous amount of restraint prevailing in the replies to the questions and indeed there was also some restraint in the questions asked. Nevertheless, I think this was a very fruitful meeting, very helpful, and we will patiently await the review that is underway. It appears that apparently the work on important issues doesn't spiral from the top down, but resembling a plant growing in the springtime, from a seed going upward, trying to break through clay—"Ikle"—in this instance.

Gentlemen, we are grateful for your helpful and enlightening testimony on this important subject.

This concludes the hearings of the subcommittee on U.S. chemical warfare policy. The subcommittee stands adjourned until further notice.

Thank you very much.

[Whereupon, at 4:25 p.m., the subcommittee adjourned.]

STATEMENTS SUBMITTED FOR THE RECORD BY MEMBERS OF CONGRESS

Statement of Hon. Bella S. Abzug of New York

Mr. Chairman and members of the subcommittee, I appreciate this opportunity to convey my alarm about the new direction this Nation is taking in chemical warfare. I am alarmed because of the incredibly dangerous character of existing stockpiles of deadly gases, and the still greater dangers of conversion to binary weapons. I am equally alarmed because our present stance nullifies all administration rhetoric about seeking real disarmament, and stands as a roadblock on the path to meaningful agreement.

This committee is performing a most valuable service in these hearings. If the House can come forth with a strong recommendation for ratification of the Geneva protocol of 1925, which outlaws the first use of chemical as well as biological weapons, it will give great encouragement to our negotiators. I am proud to sponsor resolutions to this effect and I hope these hearings will result in passage of legislation for ratification and a complete review of our policies.

The 1969 hearings of this subcommittee prompted Mr. Nixon to renounce the first use of biological weapons; and the concern expressed on this issue is by no means partisan. Sixteen Republican Members led by Mr. Dellenback sponsored a study of "CBW and National Security" and concluded that CBW was neither cost-effective nor certain to prove a deterrent in limited or all-out war; and that the risks outweighed any dubious advantage.

Last fall, after hearings conducted by another committee, the transportation of nerve gas was prevented and the Army announced that 500,000 gallons stored in Colorado would be destroyed. That still left vast quantities of these terribly toxic materials stored at eight other locations around the country.

At the same time, the Army announced a new plan for manufacturing "binary" weapons. One component, similar to organophosphate insecticides, would be placed in projectiles at a military plant in Pine Bluff, Ark. The other component, an alcohol reagent obtained commercially, will be shipped, stored, and handled in a separate canister that will be loaded into the weapon just before firing.

Supposedly this new binary method of production would reduce the danger, since the separate chemicals do not become lethal until the shell is spinning toward its target.

However, the overall risks of this totally new strategy are tremendous. Arms specialist Herbert Scoville, Jr., a former high-ranking official in the Defense Department, the CIA, and the ACDA, points out that it is a vast jump from conventional to nuclear war. By interjecting chemical weapons, he says, "you are putting an intermediate

step in the escalation of warfare to weapons of mass destruction.* * *" Chemicals, in other words, are a temptation to retaliation.

The Army argues that we must go on manufacturing such weapons to deter an attack on the United States. What country, I ask, is likely to attack the United States with nerve gas, in this age of nuclear overkill? It would be the least efficient method and would invite immediate nuclear retaliation.

Nerve gas is actually manufactured for the use of our European allies in case of an attack by the Soviets on European soil. But it would take weeks or even months to transfer it in case of such an attack. Once again, an attack with conventional or nuclear weapons is far more probable than the use of nerve gas. Those who would use it must themselves be equipped with cumbersome gas masks and body armor. Meanwhile, we store it for our friends because they don't want the risk of such potent chemicals on their shores.

If we were really seeking to defend the United States from chemical warfare, we would be manufacturing gas masks and body armor. Mr. Evans of Colorado has correctly stated that "the supreme irony of our chemical nerve agents is that they pose the greatest danger to our own people." Dr. Fred C. Ikle, Director of the Arms Control and Disarmament Agency, has stated his belief that the threat of nuclear response is in itself enough to persuade the Soviet Union against a nerve-gas attack.

The question, then, is, "Why should the United States be in the business of producing nerve gas at all? As you know, until Vietnam, nerve gas had not been used since World War I because public opinion recoiled at its effects. Nonetheless the Pentagon went on developing far more incapacitating agents than had ever been known before. Vietnam was a testing ground for the effectiveness of riot control agents and herbicides. In limited situations like Vietnam, they are all too effective; according to a recent study by the National Academy of Sciences, it will take 100 years for Vietnam's defoliated forests to grow again.

There is reason to suspect that birth defects are linked to herbicides in the food chain. The immorality of such use is obvious; to devastate a country's food supply is criminal, even in war. But we do not admit to any such offensive purpose. We continue to insist that nerve gas is for "defense." Instead of renouncing chemical warfare, we are proceeding to spend ever greater amounts developing it.

We are also increasing the ease with which any small nation, or even any small group of terrorists, can acquire such weapons and hold entire nations hostage. Chemical agents have long been called the poor man's nuclear bomb. The Pentagon's new proposal simply makes it cheaper and more available. Even now, we are training foreign military officers in the use of nerve gases; they will be well prepared to aid military coups in their own country, and to threaten ours.

But the binary system will not be cheap for the American people. Six million dollars is requested for research and development in 1975, and another $6 million to construct a facility at Pine Bluffs for the manufacture of these weapons. An initial $400 million is projected for the reconversion, and the eventual cost is expected to be $1.5 billion to $2 billion. This would keep us in the nerve gas business for years to come.

This is in direct conflict with our supposed goal of reducing and controlling armaments. Our international posture in this issue does not appear to be good-faith bargaining. While our negotiators at Geneva continue to "express interest" in banning chemical weapons, they have produced no concrete proposal. Instead, the White House and the Pentagon announced the binary conversion. What we should be saying is that we are ready at once to end our program of manufacturing and stockpiling such weapons, and immediately to destroy our existing stockpiles. The Russians, meanwhile, have gained a propaganda advantage by proclaiming their willingness to halt the production and use of chemical agents.

But our administration, just last week, again refused to include riot control agents and herbicides in any agreement, claiming that there is still military value in these weapons. The Senate will not accept this view, and is urging the kind of review that we propose in the legislation before us.

One cannot help wondering whether the administration's goal is really disarmament or the imposition of a Pax Americana, still, by way of such American aid as our development of chemical weapons for the benefit of our European allies.

The budget for the Arms Control and Disarmament Agency for fiscal year 1975 is around $9 million. The Defense Department's budget is around $90 billion. This in itself indicates the relative importance of the agencies to this administration. The Disarmament Agency has been downgraded and its members no longer head important arms control delegations.

U.S. insistence upon exempting irritants and herbicides from any agreement has left our negotiators in a most embarrassing position—especially since the United States introduced the Geneva protocol in 1925 and is now the only major power to refuse to ratify it.

The argument is made that methods of verification of compliance are lacking. This is the same old stall that has held up nuclear agreements. The proposed binary methods of production will make verification almost impossible, since the two components of the new weapons are chemicals used in commercial production. Who is to follow through, in this country or abroad, to see that the components are not diverted to military uses?

While we continue our pious pronouncements and our pernicious plans, we have almost put the Conference of the Committee on Disarmament out of commission. Representative Pat Schroeder, who attended its session last summer, reports the general feeling of discouragement about the U.S. position. The leader of the Mexican delegation even suggests that the U.S. plans to trigger a chemical arms race. Unless agreement can be reached to place meaningful restrictions on these weapons, Ms. Schroeder feels that the CCD's very existence is threatened.

As you recall, the CCD evolved from the 18th National Disarmament Conference of 1962, and was enlarged to 26 members in 1969. It has helped to achieve several major arms control agreements, such as the limited test ban treaty, the nuclear nonproliferation treaty, the seabeds arms control treaty, and the convention banning biological and toxin weapons. Now it is more needed than ever, as the military budgets of the major powers spiral and the threat to humanity becomes even greater.

Finally, I am disturbed as always by the tone of our discussion of the matter. We have come to accept great stockpiles of lethal weapons, close to our major cities, as a normal way of life. When the Army chief of research and development says that "open-air testing will be requested" for the new weapons, we tend to forget that 6,400 sheep—who could just as well have been people—were killed by nerve-gas testing in 1968 in the desert south of Salt Lake City. Since 1966, leaks have occurred in nerve gas containers stored at Dugway Proving Grounds, Arsenal, Colo.; Fort Greely, Alaska; and on the island of Okinawa. We have some 20,000 tons of nerve gas stockpiled around the world, from Johnston Island in the Pacific to West Germany. I would vote to approve the funds to destroy this gas safely, but I could not vote for any further development of or research on chemical agents.

I need only remember that a drop of GB the size of a pinhead can kill a person in 10 minutes. I do not want such materials stored all over the country or elsewhere, nor transformed into "safer" and more tempting shapes. I want to see them destroyed, and to see this country set its feet firmly on the path to reducing and finally eliminating all chemical and biological weapons.

Statement of Hon. Don Edwards of California

Arms control, with respect to chemical and biological warfare, is of continuing and increasing international importance. Nearly 50 years ago, the United States first began to realize the inherent dangers in this area, with the signing of the Geneva protocol in June 1925. Since that time, increased research has shown us the detrimental effects which chemical and biological warfare can have on plant and animal (including human) life.

With the advancement of science and technology in this country since 1925, the United States has become 10, or even 50 times more powerful in the field of chemical warfare. A report compiled by the Department of Defense in 1970, and several subsequent reports by the Departments of Agriculture, the Interior, and Housing, Education, and Welfare, show that in Vietnam alone, long-lasting ecological effects, drastic modifications of soil structure, and extensive agricultural damage are the results of the use of chemical warfare by the United States. Dr. Arthur W. Galston, professor of biology at Yale University, pointed out that in addition to land damage, birth abnormalities among the Vietnamese were apparently caused by exposure to these same chemical compounds. In response to the findings of the various Government agencies and other sources, the Defense Department ordered a halt to the use of the defoliant mixture "agent orange" in Vietnam in April 1970. After seeing the damage done, it is absolutely essential that a ban be put on the use of all such chemical mixtures by the United States.

The uncooperative stance that the United States took on this issue in 1925, in refusing to sign the Geneva protocol, still continues, and this policy should be immediately terminated. In 1969, a Swedish resolution stating that chemical and biological warfare was contrary to "generally recognized rules of international law" as set forth by the Geneva protocol, came before the United Nations General Assembly. The United States was one of three countries (the others being Australia and Portugal) who voted against that resolution.

It is high time that the United States joined in the ratification of the Geneva protocol, and changed its policies regarding chemical and biological warfare. At this time, 85 parties have ratified the protocol, and the United States is the only major military power which has failed to ratify. Japan was the most recent addition in May 1970. Principles of the protocol have been adhered to by most parties and nonparties alike in almost all major wars and conflicts since 1925. And yet, the United States has continued to be charged with "gross violation" of the international agreement barring chemical and biological warfare. If not in an all-out nuclear war, an extension of chemical warfare could have disastrous and far-reaching effects on the world as a whole. A strong and powerful country like ours should join the international community in this area of extreme importance, not be a straggler. I therefore urge the immediate adoption of H. Res. 679, and others, the ratification of the Geneva protocol, and a comprehensive review of U.S. policies to date in this area.

Statement of Hon. Michael J. Harrington of Massachusetts

I appreciate this opportunity to express my beliefs concerning U.S. ratification of the Geneva Protocol of 1925, the undesirability of U.S. involvement in chemical warfare and the prospects for worldwide chemical disarmament. I commend the chairman for conducting these extremely informative open hearings which have provided an opportunity for the public to become knowledgeable on a subject which the administration is reluctant to publicize.

The United States was a principal party in the drafting of the Geneva Protocol of 1925, and yet, has the dubious distinction of being the only major power not to have ratified this relatively effective disarmament agreement. Thus, many nations are understandably suspicious of U.S. sincerity in attempting to bring about world peace, due to our inexcusably long delay in ratifying the protocol.

I strongly urge prompt U.S. ratification of the Geneva protocol, without exclusion of riot-control agents and nonlethal herbicides. Nonlethal herbicides and riot control agents are definitely subject to the protocol, which prohibits the use in war ". . . of asphyxiating, poisonous and other gases and of bacteriological methods of warfare."

Mr. Nixon claims to favor U.S. ratification of the Geneva protocol, with the notable exception that the United States be allowed to employ herbicides and riot control agents for first-strike purposes. If the United States were to ratify the administration's version of the protocol, we would not be acting in good faith. If a nation, such as the U.S.S.R., considered our exception to the Geneva Protocol to be unlawful, that nation could nullify our bilateral agreement and reserve the right to use CW for first strike purposes.

The U.S. military should be prohibited from using herbicides and riot control agents. The United States was using so-called nonlethal herbicides in Vietnam in attempts at large-scale defoliation. Due to a recognition of the potential health hazard of this practice and widespread criticism at home, DOD discontinued defoliation efforts. Subsequent study has revealed that certain herbicides may have previously unsuspected detrimental effects to health and to the ecology. Health experts have indicated the possibility of paratalogical effects (birth defects) of these chemicals.

Our first-strike use of herbicides resulted in the virtual elimination of vegetation from thousands of acres in Southeast Asia. While spraying herbicides from military aircraft did not stop North Vietnamese troop movements, it has resulted in the contamination of wildlife, water bodies and land, and incorporation of toxic elements into the food-chain. Decades will pass before Vietnam's ecology recovers from the infliction of these chemicals.

On the subject of so-called riot control gases, CS-type riot gas is more poisonous than chlorine and is capable of being metabolized into cyanide. There is suspicion that CS gas has caused the death of

young people or people with respiratory disease in confined areas. The vast amount of evidence compiled on the harmfulness of herbicides and riot control agents leads me to conclude that these weapons are as inhumane as any other weapon of war covered by the protocol, that their use should be prohibited, and that the United States should cease its opposition to accepting these types of weapons as being covered by the protocol.

It seems to me that the administration is being somewhat hypocritical in preaching the virtues of arms control while simultaneously proposing unilateral development of binary chemical munitions. Lethal binary weapons, in simple terms, are formed by mixing certain chemical compounds which are relatively harmless when separated. Since the stockpiling and transportation of binaries would be safer than is the case with our present forms of nerve gases, they could be more easily used by the military.

The Department of Defense assertion that binaries would improve our military capability, and that binary weapon stockpiles and transportation would be safer, lead me to conclude that U.S. construction of these weapons would be an act of escalation. It is an apparent fact that within a few years of most U.S. development of new weapons, foreign powers often duplicate our technology. Scientific opinion generally concludes that binaries could be easily manufactured in average chemical laboratories, once the exact chemical ingredients are known. If terrorist groups or nations with relatively small tactical weapons delivery capability were to process binary munitions, the possibility of new and unprecedented types of violence in the world would increase.

Many supporters of U.S. development of binary munitions contend that we need these weapons to deter other nations—primarily the Soviet Union—from a chemical warfare attack. This "cloak" would justify a major unilateral escalation of the already severe arms race, with no apparent increase in our security. Binaries or no, chemical weapons are extremely difficult to control once released, and hence limited in their practical utility. What is more, there is no effective defense against a surprise first-strike CW attack. The nation attacking would naturally have taken measures to protect its troops, and possibly its population as well, against a retaliatory second-strike CW attack. The United States does not need this kind of retaliatory capability—in view of our strategic and tactical thermonuclear force. We have over 7,000 deliverable tactical nuclear warheads in Western Europe. Combined with the 1,000 Minuteman ICBM's, 656 Polaris-Poseidon SLBM's and a combined B-52/FB-111 bomber fleet numbering approximately 400, we have enough retaliatory capability to deter a first-strike CW attack.

U.S. unilateral development of binaries, in fact, is more likely to raise the risk of CW warfare rather than deterring attack. Development of these "safer" weapons lowers the threshold on use of CW weapons, and the parallel development that would be encouraged on the part of other nations by U.S. actions could significantly increase the likelihood that these particularly inhumane and indiscriminate weapons would be used.

U.S. chemical warfare programs over the last decade have cost the American taxpayer well over $500 million. While the Department

of Defense is presently requesting only $5.8 million for the binary CW program, it is estimated that as much as $2 billion will be required to bring the program to completion. I am convinced that we cannot afford this kind of expense for weapons that will only endanger the security of our Nation, and which are wholly unnecessary.

In conclusion, I believe that ratification of the Geneva protocol of 1925 by the United States and abandonment of proposals to produce binary weapons would significantly increase the chances of world peace. The Convention on Chemical Disarmament (CCD), meeting in Geneva, is attemptng to formulate a substantive CW agreement. Unless the Senate promptly ratifies the Geneva protocol, without exclusion, it is unlikely that further agreements will be reached in Geneva. As with our progressing negotiations on strategic arms limitation, U.S. safety and worldwide peace would be enhanced by the end of a chemical warfare threat that would be achieved by a chemical warfare agreement.

STATEMENT OF HON. FLOYD V. HICKS OF WASHINGTON

In November 1969, President Nixon announced a new U.S. policy regarding bacteriological or biological warfare. The United States renounced all offensive preparations for bacteriological warfare. It is my understanding that we began to destroy all existing stocks, and that since then we have confined our activities to defensive purposes only. The fact that the Soviet Union was no doubt going forward with thier own bacteriological warfare programs notwithstanding, the United States took this unilateral step in this particular area.

Today, 4½ years later, how has our national security been affected? Are we any less safe or secure from our potential enemies? It does not appear to me to be so. We are still capable of responding to all conceivable threats against our security by conventional and nuclear means. And at the same time, we relieve ourselves of at least one kind of potential disaster: By destroying our stocks; we no longer face the possibility of a bacteriological plague generated from such stocks by accident or design. Those American communities near where bacteriological agents were stored are no longer threatened.

Today, we are faced with another important national decision. Our present stocks of nerve gas are reaching the end of their useful life. Within 2 years time, we must decide whether or not to replace existing stocks with another generation of nerve gases—the so-called binary systems. In my view, we should not take this step.

The proponents of binaries argue that we need nerve gas for deterrence and for retaliatory purposes. This argument while valid for nuclear weapons, does not necessarily follow for nerve gas. Before using nuclear weapons, our adversaries would have to weigh the inevitable damage resulting from a nuclear response. That nuclear retaliatory strike can be against open cities or military targets. As a deterrent, nerve gas is probably useful only against cities, because military personnel should be prepared to take countermeasures for gas. I see no advantages for using gas against cities rather than nuclear weapons. If we are to retaliate against open cities, we might just as well rely upon a known commodity—our nuclear stockpile.

The argument for retaliation breaks down for one reason: we do not have to retaliate in kind. According to various reports based on material captured by the Israelis in the October war, the Soviets have advanced capabilities to defend against lethal chemical agents. That would seem to make it more reasonable to respond by some other method—either conventional or nuclear, to a lethal gas attack.

Another argument on behalf of binary development and procurement is not to give anything away. We are currently engaged in sensitive negotiations at Geneva concerning just this topic. A unilateral step will destroy our negotiating position vis-a-vis the Soviets.

Of course, in that sense we gave away the option to use biological agents. Possibly, this has hurt our bargaining position; I don't know.

But I do know that it was the sensible thing to do. As I have stated, and as everyone recognizes, our renunciation of biological warfare has enhanced our national security by removing the possibility of an accident or misuse involving bacteriological warfare stocks.

Finally, it is argued that binaries are safer to produce, store, transport, and dispose of than their predecessors, due to their compartmentalized design.

My response to this argument is quite simple. Sure, they're safer than the 40 million pounds of nerve gas we've presently got, but nerve gas isn't safe, period.

When we're talking about the public safety aspects of binaries, we ought to consider a few other points. As the production techniques of binaries are simpler than their predecessors, the possibilities for duplication are easier. This means duplication by other governments and duplication by other interested parties. I think it would be most unwise to give the binary program the increased visibility that would inevitably arise with the publicity surrounding procurement, storage, and transportation.

Quite apart from these arguments, I believe there are two perfectly legitimate reasons not to go forward with this program. First, binaries are clearly inferior to their predecessors in terms of their battlefield applications. They are less effective, less controllable, and less predictable than the nerve gas we already possess. This is one major reason why the Soviet Union, as I understand it, is not pursuing binary developments.

The second unassailable reason to terminate the program revolves around dollars and cents. The estimates I have seen, both in and out of Government, for the total cost of the transition to binaries, runs to the tune of $2 billion. Granted, around $750 million of this amount is as good as expended already—this is the cost of detoxifying existing stocks. This must be done as existing stocks are nearing the end of the time when they can be safely stored, if they are not there already. Of the remaining $1.25 billion, minor costs have been expended on research and development. As for the remainder, if it must be spent on chemical warfare, we might just as well spend it where it would do the most good for our men in uniform: We should spend it on defensive equipment. Since they are not going to use nerve gas first, they should have defensive equipment comparable to that of potential adversaries.

I would like to propose another alternative to the development and procurement of binary systems, a proposal that in my estimation would not detract from our national security.

I propose that our country adopt a policy for nerve gas similar to that we have already taken with bacteriological weapons. We should renounce any offensive capabilities, detoxify existing stocks, and maintain a vigorous defensive-oriented program. Let us reaffirm our "no first use policy." Existing stocks must be detoxified in any case, let us do so along with an announcement that we reject the option of retaliation in kind, insofar as nerve gas is concerned. If the United States were attacked by lethal chemical agents, we reserve the right to retaliate by whatever means we have at hand, nuclear or conventional. The same dictum should hold true for our allies, in accordance with our treaty obligations.

These actions would enhance our national security by removing the specter of another Dugway incident in the continental United States. It would improve relations with some of our allies, on whose territory existing stocks are placed.

As we would continue to rely on our nuclear and conventional stockpiles, this unilateral step would not jeopardize our defense posture. If other countries are foolish enough to waste their national treasure on such programs, let them go ahead. My own view is that other countries would take their cues from the United States on this matter. I would emphasize the need for economic data monitoring of these substances that go into the production of nerve gases to verify the actions of others. This should be the focus of our negotiating at Geneva. Existing stocks need not be monitored—they will decay in any case, and will need to be destroyed.

I would hope that this administration, which terminated offensive bacteriological warfare programs, will likewise terminate the binary program. In any event, there is much the Congress can do. These hearings will be extremely helpful in raising the important issues, and in generating responsible public debate. House Resolutions 679 and 710 to express the sense of the House that the Geneva protocol be ratified are entirely in order, and should be commended. But the heart of the issue is in dollars and cents. And this representative body has the authority to strike out expenditures designated for binary systems. In the final analysis, this is where the House must draw the line.

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APPENDIX

DOD Correspondence Regarding the Cost of Chemical Warfare Programs

Assistant Secretary of Defense
Washington, D.C., April 16, 1974.

Mr. Werner Grosshans,
Associate Director, Logistics and Communications Division, U.S. General Accounting Office, Washington, D.C.

Dear Mr. Grosshans: In response to your letters of December 10, 1973, and February 8, 1974, to the Secretary of Defense (code 947080) the enclosed information on the costs of chemical warfare programs is furnished.

The responses of the Armed Services have been received and are attached. It is our belief that the costs shown are as accurate as it is possible to obtain since detailed records are not available for programs of 20 years ago and some records have been accidently destroyed, notably those lost in the fire of July 13, 1973, at the Air Force Records Center in St. Louis.

Please note that one page (incl. 6 to incl. 2) of the Army's response is classified "Confidential," and one page (incl. 3 to incl. 2) is classified "Secret." The remainder of this reply is unclassified.

We have attached as enclosure 1, explanation of certain items which may not be completely clear from the service responses and we hope that you will find this information sufficient and satisfactory for your requirements.

Sincerely,

Hugh E. Witt,
Principal Deputy Assistant Secretary of Defense (Installations and Logistics).

Enclosures:
1. Explanatory notes.
2. Army report.
3. Air Force report.
4. Navy report.

EXPLANATORY NOTES

1. Costs shown deal with nerve agents and nerve agent munitions only, except where it is impossible to separate that cost (such as in the question dealing with total personnel and physical plant costs at the storage sites) or as otherwise noted.

2. With respect to question 1b and 1c in the Army report, the questions were interpreted as being directed toward the cost of maintaining a constant stockpile. This has not been done. As munitions have become unserviceable they have been removed from the stockpile. There has been no procurement of replacement items, either in kind or improved.

3. With respect to question 5, the answer is intended to indicate that all costs of delivery systems are included in the R. & D. and production and procurement costs given in response to other questions.

4. The Navy and the Air Force do not store or maintain nerve agents separately. Therefore, their costs have been limited to R. & D., testing and procurement. The maintenance costs shown in 1961 and 1966 for the Marine Corps were costs for work performed by the Army and reimbursed by the Marine Corps. It consisted of replacement of some explosive components of Marine munitions.

COST OF CHEMICAL WARFARE PROGRAMS (GAO CODE 947080)

1. A detailed review of Department of Army records has been conducted to identify all relevant costs incurred in the development, procurement, storage and disposal of chemical warfare nerve agents.

2. Recovery of data for prior years has been limited to the records authorized for retention under the provisions of the Army functional file system (TAFFS), AR 340–18. Much of the data contained in this study was obtained from convenience summary documents retained for year-end historical information. Although the data contained in these documents is presumed to be correct, it cannot be verified by audit techniques since the accounting records from which the costs were obtained have been destroyed in accordance with TAFFS.

3. In order to insure that all requested data is provided, the following information is keyed to the questions asked in the GAO letter of December 10, 1973, and the ASD (I. & L) memorandum of February 8, 1974.

4. Replies to all questions are limited to those costs related to nerve agents only, unless specifically stated.

SECTION A

Question 1a. What has been the total cost of our existing toxic stockpiles including costs for research development (preliminary and advanced), engineering, testing, and production (procurement, government facility costs, transportation, storage inventory)?

Answer. All of the lethal chemical weapons in our existing stockpile were type-classified prior to fiscal year 1964. Therefore, no research, development, engineering or testing costs since fiscal year 1964 are attributable to the current existing stockpile. The limited R.D.T. & E. data that is available from convenience summary papers held for historical information, covering the period fiscal year 1959 through fiscal year 1963, amounts to $1.798 million. However, this figure does not reflect total costs. Details by year and item are shown in enclosure 1. Production costs, detailed in enclosure 2, amount to $150.843 million. In summary, reflected R.D.T. & E. and production costs (fiscal year 1959–63) total $152.641 million. Enclosure 3 is a break out of the dollar value of the current storage inventory by location. This inventory represents the book value of nerve agents on hand as of March 15, 1974.

Question 1b. What costs have been incurred to dispose of stockpile items?

Answer. No stockpile (serviceable) stocks have been demilitarized.

Question 1c. What costs have incurred to replace in kind, items disposed of?

Answer. Since no serviceable stocks have been disposed of, no costs have been incurred to replace items in kind.

Question 2. What, on an annual basis, has it cost the United States to maintain existing stockpiles?

Answer. Operating costs at storage facilities are not maintained on a commodity basis; that is, specific costs are not shown for storage and maintenance of nerve agents. However, from available records for fiscal year 1972 and fiscal year 1973 it has been computed that costs attributable to storage of nerve agents amounted to $1,672,000 and $1,518,000 respectively. Because operating cost records prior to fiscal year 1972 have been retired, similar computations for fiscal year 1964 through fiscal year 1971 cannot be made. However, it is assumed that the annual costs approximated $1,500,000 between fiscal year 1964 and fiscal year 1971 since the total stockpile varied little during that period.

Question 3. What will it cost to eliminate present stockpiles?

Answer. Detailed plans have not been prepared concerning disposal of the total current chemical deterrent/retaliatory stockpile, therefore estimates of cost are not available. The impact of the introduction of binary systems on the current chemical stockpile has not been evaluated.

Question 4. What cost is included in the present budget for chemical warfare, using the same detail as in question 1, and including a breakout of costs associated with chemical agent activities at Tooele Army Depot?

Answer. The fiscal year 1974 and fiscal year 1975 budgets include $9,115,000 and $24,139,000 respectively, applicable to lethal nerve agents. Inclosure 4 is a detailed breakout of types of costs by fiscal year. The production costs for CAMDS of $3,200,000 in fiscal year 1974 and $10,300,000 in fiscal year 1975 are for activities at Tooele Army Depot. CAMDS is further discussed in response to question (2), section B.

Question 5. In addition to costs associated directly to R.D.T. & E. and production and procurement, what additional costs can be identified such as design, development, testing, and production of munitions specifically for delivery of nerve agents on targets, for example, spray tanks, artillery shells, rockets, and any other special munitions?

Answer. There are no known costs in addition to those directly associated with R.D.T. & E., or production and procurement for munitions specifically for the delivery of nerve agents on targets.

Question 6. What has been and is now the cost of maintaining laboratory programs at the Army facilities used for designing, developing, and testing of chemical warfare agents?

Answer. The Army's design and laboratory work on lethal chemical systems is conducted by Edgewood Arsenal, Md., while the testing is accomplished by Dugway Proving Ground, Utah. Inclosure 5 shows the detailed costs by function and by fiscal year, and total $75.4 million.

SECTION B

The following questions were forwarded to the Army with the ASD (I&L) memorandum dated February 8, 1974.

Question (1). Binary munitions system Total funds, expended thus far on R.D.T. & E. in reaching the present stage of development.

Answer. The actual costs for research and development for the 155mm and 8-inch binary projectiles amount to $11.13 million through fiscal year 1973. Inclosure 6 provides the details of the total R. & D. costs and costs for production base and procurement for these two systems.

Question (2). Costs to destroy the existnig stockpiles of nerve agent. The news media have provided data which are quite divergent. Some indication of these costs, including the construction of the transportable chemical weapons destruction system, will be useful as a reliable base to start our discussion.

Answer. As stated in the answer to Question 3, section A above, there has been no Department of the Army study to determine the cost of destroying the existing stockpile. The transportable chemical weapons destruction system is now referred to as the Chemical Agent/Munitions Disposal System (CAMDS). As stated in the answer to question 4 above, the fiscal year 1974 and fiscal year 1975 budgets have included a total of $13.5 million for development of CAMDS. It is estimated that the prototype of CAMDS will cost a total of $36.6 million. Following successful operational testing of the prototype, additional disposal units will be procured for use at chemical storage sites as required.

Question (3). The total cost of our existing toxic stockpiles (nerve agent) since we first began production and stockpiling of these agents. This estimate would include the cost of the VX and GB production plants, the munitions design and production costs, the agent production costs, and the storage facilities costs.

Answer. This question has been answered under Question 1a, section A, together with Inclosure 2.

Question (4). (a) What does it cost us on an annual basis to maintain our current stockpile in nerve agents?

Answer. The answer to this question is the same as the answer to Question 2, section A, above.

Question (4). (b) What are our personnel and physical plant costs at the seven or so sites where these agents are stored?

Answer. The current estimated personnel and physical plant costs for fiscal year 1974 at the seven CONUS sites where these agents are being stored are as follows:

The listed installations have a complete storage mission for general supplies and ammunition, of which a minor part is attributable to nerve agents.

Tooele Army Depot	$70, 947, 000
Anniston Army Depot	80, 954, 000
Blue Grass Army Depot	57, 615, 000
Umatilla Army Depot	3, 576, 000
Pine Bluff Arsenal	24, 932, 000
Rocky Mountain Arsenal	13, 506, 000
Newport Army Ammunition Plant	1, 446, 000

Question (5). What proposition of total costs at Edgewood Laboratories and Fort Detrick, including in-house capital investments and personnel, is devoted to support of the chemical and biological warfare programs?

Answer. There are no lethal chemical warfare programs conducted at Fort Detrick. At Edgewood Arsenal in fiscal year 1974 approximately 85 man-years are

devoted to the lethal chemical warfare program which is about 9 percent of the total research and development personnel strength at the arsenal of 922. The pro rata share of current replacement value of equipment attributable to the lethal chemical program is approximately $2.227 million. This is about 5 percent of the estimated $45 million replacement value of all research and development equipment at Edgewood Arsenal.

Question (6). What has been the total cost of investments at Dugway Proving Ground since its inception to the present in support of CBW test requirements?

Answer. The program associated with the lethal agent testing at Dugway Proving Ground, from fiscal year 1964 through fiscal year 1973 was approximately $75 million. Funding between fiscal year 1968 through fiscal year 1973 cover test activities conducted under Desert Test Center (DTC). Dugway Proving Ground was an activity under DTC and its operational funds are included in the total DTC costs. Since 1970 the expenditure of funds in support of development involved testing with simulants except two trials conducted prior to the test moratorium.

RESEARCH, DEVELOPMENT, TEST, AND EVALUATION COSTS—LETHAL NERVE AGENTS

[In thousands of dollars]

System	Fiscal year—				
	1959	1960	1961	1962	1963
8-in howitzer VX M426		16			
Rocket 155-mm GB M55	162	25			
VX M55	59	106			
Honest John (VX and GB)	280	181			
GB			46	56	
VX			90	62	715

Note: The limited data above that is available is presumed to be correct; however, it cannot be verified by audit techniques since the accounting records have been destroyed in accordance with existing regulatory policies.

PRODUCTION COSTS OF NERVE AGENTS BY INSTALLATION

[In millions of dollars]

Fiscal year and installation	Procurement	Government facility costs (production bases)	Transportation	Total
Prior to 1964		131.0		
GB production facilities		(101.0)		
VX production facilities		(30.0)		
1964	1.529	[1] .776		
Rocky Mountain Arsenal		(.157)		
Newport Army Ammo Plant		(.619)		
1965: Newport Army Ammo Plant		.173		
1966: Newport Army Ammo Plant	3.421	.141		
1967: Newport Army Ammo Plant	.184	.360		
1968	.251	.473		
Rocky Mountain Arsenal		(.100)		
Newport Army Ammo Plant		(.338)		
Edgewood Arsenal		(.035)		
1969	1.563	.040		
Newport Army Ammo Plant		(.025)		
Edgewood Arsenal		(.015)		
1970	—.300	0		
1971: Johnston Island	.076	([2])	[3] 4.190	
1972	.032	0		
1973	.215	0		
Total	7.804	138.849	4.190	150.843

[1] 1st destination transportation costs are included in procurement costs.
[2] Represents the construction of storage facilities.
[3] Represents the total cost of transporting Red Pat (nerve agents) from Okinawa to Johnston Island.

COSTS INCLUDED IN THE PRESENT BUDGET FOR LETHAL NERVE AGENTS

[In thousands of dollars]

	Fiscal year—	
	1974	1975
R.D.T. & E.	$4,815	$6,939
Exploratory development	($870)	(1,020)
Advanced development	(1,310)	(1,025)
Engineering development	(2,635)	(4,894)
Production	3,200	16,100
Chemical agent/munitions disposal systems (camps)	(2,500)	(9,600)
Advance engineering	(700)	(700)
Chemical production and LAP facilities for 155 binary projectile XM687	0	(5,800)
Storage costs	1,100	1,100
Total	9,115	24,139

LETHAL CHEMICAL R. & D. PROGRAMS

[In millions of dollars]

	Fiscal year—										
	64	65	66	67	68	69	70	71	72	73	Total
Exploratory development	0	2.535	2.131	1.038	1.879	1.767	2.047	3.008	1.816	1.380	17.601
Advanced development	.315	.472	.326	.965	.318	.469	1.197	1.403	2.508	2.925	10.898
Engineering development	3.523	2.295	3.677	5.294	4.533	1.283	.475	0	0	1.077	22.157
Test [1]	1.719	1.086	3.115	1.558	2.130	3.811	[2] 2.097	2.134	3.395	3.710	24.755
Total	5.557	6.388	9.249	8.855	8.860	7.330	5.816	6.545	7.719	9.092	75.411

[1] Funds shown from fiscal years 1968 to 1974 cover test activities conducted under Deseret Test Center (DTC). Dugway Proving Grounds (DPG) was an installation under DTC and its operation funds are included in the total DTC costs. It is not possible to identify the DPG segment of any total fiscal year cost for DTC.

[2] All experditures of funds in support of development involved testing with simulants except 2 trials conducted prior to the test moratorium.

DEPARTMENT OF THE AIR FORCE,
HEADQUARTERS AIR FORCE SYSTEMS COMMAND,
Andrews Air Force Base, D.C., March 15, 1974.

Subject: GAO review of cost of chemical warfare programs (your letter, February 1974).

To: Headquarters USAF/RDP.

1. References:

a. GAO letter dated December 10, 1973, to Secretary of Defense requesting costs of chemical warfare programs.

b. OASD audit memorandum dated December 11, 1973, to Secretary of the Air Force requesting information.

c. Headquarter USAF/ACG letter dated December 14, 1973, appointing Headquarters USAF/RDM as OPR for GAO report.

d. Headquarters USAF/RDPA letter to AFSC/SDW dated January 4, 1974, requesting action be initiated to identify sources to insure timely response to DOD.

e. OASD letter to Secretary of the Air Force dated January 10, 1974, identifying cost requirements.

f. Headquarters USAF/RDP letter to AFSC/SD dated February 7, 1974, directing AFSC as lead command prepare GAO report by March 15, 1974.

g. SDW message 281830ZJan. 74 to ADTC/ACBR, Subject: GAO review of cost. [Request for cost information.]

h. AMCRD–WB message 310800ZJan 74 to U.S. Army Armament Command/AMSAR–RDN, Rock Island, IL and Test and Evaluation Command, TECOM, Aberdeen Proving Ground, MD, Subject: GAO review of cost. [Request for cost information.]

i. AFLC/MMWM confidential message 012030ZFeb74 to AFSC/SDW, Subject: GAO Review. No cost figures available at AFLC.

j. AFSC/SDWC message 041945ZFeb74 to ADTC/ACBR. Reporting date extended to March 13, 1974.

k. AMCRD–WB message 061300ZFeb74 to ARMCOM and TECOM, same subject. Reporting date extended to March 13, 1974.

l. ADTC/ACB message 082030ZFeb 74 to AFSC/SDW, same subject. Record search negative, no cost data available.

m. TECOM/AMSTE–CP–B letter to AMCRD–WB, same subject, dated February 12, 1974. CW testing costs listed for fiscal year 1964 through fiscal year 1974.

n. STEDP–CP–B letter to AMCRD–WB, same subject, dated February 13, 1974. CW testing costs for years 1964–69.

o. AFSC/AC letter to SDW, same subject, March 12, 1974. Fire destruction of records.

2. Action was initiated to provide the requested information in the referenced letters, 1.a. through 1.f. However, it was not possible to establish a clear accurate audit trail for expenditures on chemical nerve agents for the years prior to 1964. This is due to records being retired, destroyed, or consolidated. Consolidation consisted of recording all chemical (CW, BW, and Defense) program funding as annual expenditures under a single program element number, therefore making it impossible to single out nerve agent costs.

3. The following listed USAF chemical testing program costs relating to nerve agent and/or simulant for nerve agent systems financed by reimbursable orders to Dugway Proving Ground were obtained from the Comptroller/Dugway Proving Ground. These are the only testing costs that have been identified separately from total R. & D. funding.

Fiscal year:	*Funds (thousands)*	Fiscal year:	*Funds (thousands)*
1964	$253	1967	125
1965	44	1968	454
1966	42	1969	1

Dugway reports that the funding costs listed above for fiscal year 1964 through fiscal year 1969 were obtained from convenience summary documents retained for year-end historial information. Since the accounting records from which the costs were obtained were destroyed in accordance with existing regulatory policies, the costs cannot be verified by audit techniques, therefore, it is presumed that the data obtained from the historical documents are correct.

4. The funding summary listed below was complied from project file folders, historical documents and convenience summary documents. Again, since the accounting records from which the costs prior to fiscal year 1969 were obtained were destroyed in accordance with existing regulatory policies or by accident, the costs cannot be verified by regular audit techniques. From fiscal year 1953 to 1964, the lack of exising documentation does not permit separating the nerve agent costs from total CB expenditures (offensive and defensive). For the years fiscal year 1964 to fiscal year 1969 the funding shown represents the best information on chemical nerve agent funding that we have been able to retrieve. In columns which contain no entries the funding level is not known.

Chemical/biological/defense—total funding

Fiscal year:	*Total (millions)*	Fiscal year:	*Total (millions)*
1953	$5.109	1959	0
1954	7.792	1960	0
1955	4.522	1961	0
1956	1.327	1962	1.900
1957	1.020	1963	13.522
1958	.090		

CHEMICAL NERVE AGENT (ONLY)—TOTAL FUNDING

	R. & D.	Test	Production	Total (millions)
Fiscal year–				
1964	3.671	0.253	0	3.924
1965	4.782	.044	5.011	9.837
1966	7.829	.042	0	7.871
1967	7.415	.125	0	7.540
1968	2.704	.454	0	3.158
1969	2.663	.001	0	2.664
1970	0	0	0	0.
1971	0	0	0	0
1972	0	0	0	0
1973	0	0	0	0
1974	.005	0	0	.005

5. In summation, it has not been possible to provide an audit trail of all chemical warfare programs relating to chemical nerve agents. As noted in reference "o." the AFSC Comptroller's Office (AC) retained, retired, or destroyed official records according to AFM 12–50. The applicable official chemical warfare program records were retired to the repository in St. Louis, Mo. Inquiry at St. Louis to support this funding review disclosed that the files had been destroyed in the fire which occurred on July 13, 1973, in the National Personnel Records Center, St. Louis, Mo. The funding information presented in paragraph 4 above, although the best available, is not complete due to the difficulty of retrieving information from a variety of historical, technical, but unofficial (nonaudit) sources. It does represent the best information obtainable by this headquarters in fulfillment of the basic request for funding information on chemical warfare programs relating to chemical nerve agents. References "g." through "o." in paragraph 1 document the information that has been obtained.

WARREN S. WOIROL,
Colonel, USAF,
Director of Armament, DCS/Systems
(For the Commander).

COST DATA FOR MARINE CORPS TOXIC MUNITIONS [1]

[Dollars in thousands]

Fiscal year	Procurement	Maintenance	Testing/ surveillance	Totals
1956	$1,618.3	0	0	$1,618.3
1960	0	0	1.8	1.8
1961	0	84.9	1.6	86.5
1962	0	0	5.0	5.0
1963	4,105.6	0	6.0	4,111.6
1964	2,161.2	0	7.0	2,168.2
1965	0	0	5.8	5.8
1966	391.3	670.6	6.5	1,068.4
1967	559.1	0	0	559.1
1968	1,960.2	0	0	1,960.2
1969	0	0	4.5	4.5
1970	0	0	5.3	5.3
1971	0	0	11.5	11.5
1972	0	0	5.4	5.4
1973	0	0	15.6	15.6
1974	0	0	11.7	11.7

[1] Data do not include costs of standard fuzes, propelling charges, primers, etc. which are common for use with both chemical and conventional artillery projectiles. Further, the Department of the Army develops, stores, and performs all disposal for the Marine Corps on a nonreimbursable basis, and performs all other functions listed in par. 1 of the GAO letter.

COST DATA FOR NAVY TOXIC/CHEMICAL WARFARE PROGRAMS

A. PROCUREMENT, STORAGE, AND SURVEILLANCE

[In thousands of dollars]

	Procurement cost of nerve agents and munitions containing nerve agents	Storage and surveillance cost of chemical warfare and bulk agents at U.S. Army storage activities [1]	Totals
Fiscal year—			
1962	1,167.0	0.0	1,167.0
1963	1,803.8	31.0	1,834.8
1964	1,970.3	47.0	2,017.3
1965	1,155.9	32.9	1,188.8
1966	830.8	75.0	905.8
1967	3,254.6	78.0	4,032.6
1968	1,857.3	135.0	1,992.3
1969	0	15.0	15.0
1970	0	76.8	76.8
1971	0	122.2	122.2
1972	0	2.4	2.4
1973	0	104.5	104.5
1974	0	6.0	6.0

[1] Storage and surveillance costs are for the total Navy stockpile in Army storage. Nerve agents and munitions are estimated to account for about 50 percent of this cost; the other 50 percent is for other chemical warfare material.

B. RESEARCH AND DEVELOPMENT

[In millions of dollars]

Program	Fiscal year—			
	1965 and prior	1966	1967	1968
EDO aero 14B tank	1.5	0	0	0
Binary (G)	0	.5	.5	.5
BIGEYE binary (V)	0	2.1	2.0	2.3
WETEYE (G)	0	.93	.93	.93
Binary bomblet (G)	0	.5	.5	.5
Total	1.5	4.03	3.93	4.23

SUMMARY OF NERVE GAS COSTS AS REPORTED BY THE DEPARTMENT OF DEFENSE

Item	Prior to fiscal year 1964–65	Fiscal years 1964–73	Fiscal years 1974 and 1975 [1]	Total
R.D.T. & E.:				
Army	$1,798,000	$75,411,000	$11,754,000	$88,963,000
Air Force	(*)	29,983,000	[2] 5,000	29,988,000
Marine Corps	0	0	0	0
Navy	1,500,000	12,190,000	----------	13,690,000
Total	3,298,000	117,584,000	11,759,000	132,641,000
Facilities:				
Army	131,000,000	7,849,000	[3] 19,300,000	158,149,000
Air Force	0	0	0	0
Marine Corps	0	0	0	0
Navy	0	0	0	0
Total	131,000,000	7,849,000	19,300,000	158,149,000
Procurement: [4] All services	187,181,300	26,955,700	0	214,137,000
Transportation: [5]				
Army	0	[6] 4,190,000	0	4,190,000
Air Force	0	0	0	----------
Marine Corps	0	0	0	----------
Navy	0	0	0	----------
Total	0	4,190,000	0	4,190,000
Operating costs:				
Army	(*)	[7] 15,190,000	[8] 2,200,000	17,390,000
Air Force	0	0	0	0
Marine Corps	99,300	732,200	[2] 11,700	843,200
Navy	31,000	688,800	[2] 6,000	725,800
Total	130,300	16,611,000	2,217,700	18,959,000
Grand total	321,609,600	173,189,700	33,276,700	528,076,000

*Not furnished.
[1] Budgeted costs.
[2] Fiscal year 1974 only.
[3] Includes production and advanced engineering costs for CAMDS.
[4] The total of $214,137,000 represents the value of the existing stockpile as of Mar. 15, 1974. Procurement for the period prior to fiscal year 1964 was computed by subtracting procurement cost furnished for the fiscal years 1964–73 period from the total stockpile costs. A breakout by service was not provided by DOD.
[5] 1st destination transportation costs included in procurement costs.
[6] Costs of moving agents from Okinawa to Johnston Island.
[7] Estimated and actual costs, see sec. A, question 2.
[8] Storage costs only, see enclosure 4, to Army section.

SUMMARY OF R.D.T. & E. COSTS REPORTED BY DOD FOR ARMY DELIVERY SYSTEMS WITH TOTAL R. & D. COSTS AND DOLLAR PROCUREMENT FOR PERIOD FISCAL YEAR 1964–73

R.D.T. & E.	Fiscal year—												Total
	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1968–73	
8-in howitzer VX M426		$16,000	0	0	0	0	0	0	0	0	0	0	$16,000
Rocket 155 mm:													
GB M55	$162,000	25,000	0	0	0	0	0	0	0	0	0	0	187,000
VX M55	59,000	106,000	0	0	0	0	0	0	0	0	0	0	165,000
Honest John	280,000	181,000											461,000
GB			$46,000	$56,000	0	0	0	0	0	0	0	0	102,000
VX			90,000	62,000	$715,000	0	0	0	0	0	0	0	867,000
155 mm GB			0	0	0	0	0	0	0				
8-in VX			0	0	0	0	0	0	0			$11,130,000	11,130,000
Total	501,000	328,000	136,000	118,000	715,000	0	0	0	0			11,130,000	12,928,000
Total R. & D. program						$5,557,000	$6,388,000	$9,249,000	$8,855,000	($8,860,000)	($7,330,000)	45,362,000	75,411,000
Procurement [1]						1,529,000	833,000	3,421,000	184,000	(251,000)	(1,563,000)	1,837,000	7,804,000

[1] Government facility costs prior to fiscal year 1964: GB production—$101,000,000; VX production—$30,000,000; total—$131,000,000.

A Glossary of Terms

ACDA

An acronym for the U.S. Arms Control and Disarmament Agency.

AGENT ORANGE

A 50-50 mixture of the herbicides 2,4D and 2,4,5T, compounds designed to defoliate or kill broad leaved plants. This is the compound used so extensively in Vietnam, and which raised the issue of extensive and permanent ecological damage as well as the potential danger of birth deformities in humans. See the summary of the National Academy of Sciences Report included in the reference materials - Congressional Record, February 28, 1974, pp. S2425-S2442 for additional information on the Academy report.

ANTI-CHOLINESTERASE AGENTS

The chemical warfare agents known as nerve agents are anti-cholinesterase agents. These chemicals interfere with the enzymatic activity at the nerve-muscle junction where the enzyme cholinesterase is secreted. Interference with this activity produces the convulsions and paralysis leading to rapid death.

BACTERIAL TOXINS

These are extremely poisonous substances excreted by certain bacteria such as Clostridium botulinum. Botulinus toxin was one of the biological warfare agents of great interest in this country. Toxins are included in the President's ban on biological warfare agents. See Congressional Research Service Report 71-37SP, pp. 23-25 for a summary of the controversy relating to the President's final decision to include bacterial toxins among the biological warfare agents to be destroyed.

BINARY CHEMICAL MUNITION

The binary munition differs from a conventional chemical warfare munition in that instead of containing actual toxic (nerve agent) chemical, the binary is loaded while in storage with one relatively harmless chemical with a second ingredient stored separately and loaded only when the munition is to be used. Thus the term "binary" or two part munition. After loading the second chemical ingredient,

the firing of the munition initiates the mixing of the two ingredients and the nerve agent is generated in flight to the target. This arrangement does away with the hazard of storing a munition loaded with a toxic agent although there are more complicated logistics problems. See Congressional Research Service Publication 74-21SP, pp. 32-36 for more information. The Army has announced that it is about to go into production of this chemical munition. See also the March 25, 1974 New York Times article provided in the reference package for an analysis of the binary by an international authority.

BIOLOGICAL WEAPONS CONVENTION - UNITED NATIONS

This is a convention negotiated by the Geneva Conferences of the Committee on Disarmament. The exact title is the Convention on the Prohibition of the Development, Production, and Stockpiling of Bacteriological (Biological) and Toxin Weapons, and on their Destruction. It was signed by President Nixon on April 10, 1972 and submitted to the Senate for advise and consent to ratification on August 10, 1972. No action has been taken in the Senate. A copy of the letter of transmittal and of the Convention is included in the Congressional Research Service Report 72-264SP, pp. 40-53. The Convention has already been ratified by a number of Nations. The U.S. has already destroyed its biological warfare stockpiles although the Convention has not been ratified in this country. Article IX of the Convention reaffirms the objective of effective prohibition of chemical weapons and contains an undertaking to continue negotiations with a view to reaching early agreement on effective measures to eliminate such weapons. Thus, ratification of the Biological Weapons Convention is associated with current negotiations at Geneva on a CW Convention as well as being indirectly related to policy decisions on the Geneva Protocol of 1925.

CBR

This acronym is an older term often used to refer to chemical, biological and radiological warfare. Since the U.S. no longer has an offensive biological warfare program and little if any effort is expanded on offensive radiological warfare, the term is not used in current project references. Radiological warfare in this sense involves the deliberate use of radioactive agents and is separate from the subject of nuclear weapons - or nuclear warfare.

CBW

This abbreviation refers to chemical and biological warfare. Since 1969, when the President authorized the destruction of all biological warfare weapons, the Department of Defense has preferred to use the terminology: chemical warfare (CW) and biological research - thus attempting to emphasize that all biological warfare related research is defense oriented.

CCD - GENEVA

This acronym refers to the Conference of the Committee on Disarmament which has been held for the past several years at Geneva. This committee developed and the U.N. approved a Biological Weapons Convention. Conferences are currently being held in an attempt to develop a Chemical Weapons Convention which would restrict or prohibit research, development, testing, engineering, production and stockpiling of chemical agents or weapons. The Conference has made very little progress because of the great difficulty in reaching agreement on the issue of verification. See pages 17-19 of the Congressional Research Service Report 74-21SP.

CACODYLIC ACID

One of the herbicides used in Vietnam. Used for rapid defoliation and destruction of rice fields.

CONFERENCE OF THE COMMITTEE ON DISARMAMENT - GENEVA

In 1960, a Ten-Nation Committee on Disarm ment was formed. This committee was replaced in 1961 by an Eighteen Nation Committee later enlarged in 1969 to 26 Nations. Meetings are held at Geneva, usually with spring and summer sessions. France is not participating. This Committee discusses the prohibition of CBW as well as general disarmement (excluding the SALT talks between the U.S. and U.S.S.R.). Annual reports are submitted to the U.N. General Assembly. From these reports resolutions may be formulated. Two recent key actions were Resolution 2603A (XXIV) whereby a vote of 80 to 3, the U.N. indicated that it was their opinion that herbicides and riot agents were included in the Geneva Protocol (the U.S., Australia, and Portugal voted against the resolution with 36 Nations abstaining); and the recently accepted U.N. Convention on Biological Weapons. See also CCD. The Conference has devoted considerable time to the problem of a Convention on Chemical Weapons and several Nations have made treaty proposals. To this date, the U.S. has not made a specific proposal, insisting instead that the issue of verification must be resolved before treaties can be discussed.

CS

The code name for a riot control agent used very commonly in civil disturbances and one of the chemical agents used in Vietnam. CS is now being supplemented by another standard riot agent known as CR. An older riot agent, code-named CN, is no longer being used as extensively. All of these agents produce tearing, salivation, pain, and a choking sensation. Although generally noted to be non-lethal, there has been concern expressed about possible more serious side effects on children, older individuals, those suffering from respiratory diseases, and the possibility of some carcinogenic effects.

CW

An acronym for chemical warfare. The U.S. Army excludes smoke, flame, and incendiaries from this category. More recently, the President has endorsed a view in connection with the Geneva Protocol which excludes the chemicals known as herbicides or riot control agents from the agents defined as chemical warfare agents. Incapacitating as well as lethal agents are included in chemical warfare systems.

DDR & E

Director of Defense Research and Engineering. Within this Directorate, the Office of the Assistant Director for Environmental and Life Sciences has the responsibility for coordinating all of the Armed Services research, development, test and engineering projects on chemical warfare and biological research on defense against biological warfare agents.

DEFOLIANTS

These are chemical herbicides which are used to cause premature leaf fall thus eliminating concealment for guerrilla or other forces. This use of herbicides was a major objective in Vietnam.

DESERET TEST CENTER AND DUGWAY PROVING GROUND

This is the U.S. Army's major chemical warfare test center, located near Salt Lake City, Utah. Open air testing of chemical weapons, with both similants and toxic agents (when approved) is conducted at this center. Tests of defense systems are also carried out at this center. All of the Armed Services have access to the use of this facility.

DETERRENCE

With regard to CW weapons, this term is used to refer to the military justification for the maintenance of stockpiles. The position has been taken that it is necessary for the United States to have a stockpile of CW munitions so that any other nation will be deterred from the initiation of CW in a war by the threat of retaliation "in kind" by the United States.

2,4 D - 2,4,5 T

See Agent Orange. These are herbicides once used extensively in agriculture in this country. In a 50-50 mixture called Agent Orange, these compounds were used in Vietnam. See Congressional Research Service Report 70-303SP for more technical information on these chemicals.

EDGEWOOD ARSENAL

The U.S. Army's major chemical warfare research laboratory is located at this arsenal near Baltimore, Maryland.

FT. DETRICK, MARYLAND

This U.S. Army facility, located in Frederick, Maryland, was the site of all biological warfare research. The facility has been converted to cancer research and except for some Army and Navy defense related work on biological problems, is now essentially a contractor operated facility directed by the National Cancer Institute. The Department of Agriculture also conducts a limited amount of plant research. See Congressional Research Service Report 72-264SP, pp. 15-17 for more details on the conversion of both the Fort Detrick and Pine Bluff biological warfare facilities.

GB

The code name for one of the U.S. Army's nerve agents. See also VX and the article by Matthew Meselson provided in the reference materials, p. 18. GB is more volatile than VX and is generally encountered as a gas.

GENEVA PROTOCOL OF 1925

This is a treaty intended to "prohibit the use in war of asphyxiating, poisonous or other gases, and of bacteriological methods of warfare." A copy of the Protocol, together with President Nixon's letter of transmittal may be found in the Congressional Research Service Report 71-37SP, pp. 34-42. About 100 Nations have ratified this Protocol. The U.S. has not - the Protocol has still not been reported out of the Senate Foreign Relations Committee because of disagreement concerning the President's exclusion of herbicides and riot control agents from the Protocol. A pro-con discussion of this latter issue may be examined in the Congressional Research Service Report 72-264SP, pp. 9-11.

HERBICIDES

This is a term used to refer to a group of chemical agents which are used to destroy or otherwise adversely affect the growth of plants. Defoliation, for example, is another effect of certain herbicides. Several of the compounds were used in tremendous quantities in Vietnam causing considerable controversy over whether the United States was conducting chemical warfare in that war. By defining herbicides as not included under the Geneva Protocol of 1925, the President simultaneously has implied that the use of herbicides in Vietnam did not constitute "chemical warfare". One herbicide of particular interest, 2,4,5T, created considerable controversy as being suspected of causing birth abnormalities. The National Academy of Sciences has just completed a study of the effect of herbicides in Vietnam. See Congressional Research Service Report 70-303SP for more details. See Congressional Research Service Report 71-261SP, pp. 23-25 for a pro-con analysis of excluding herbicides from the Protocol. The Congressional Record, February 28, 1974, pp. S2425-S2442, provided with the reference materials, includes a summary of the report on herbicides with a forwarding letter from the Department of Defense.

INCAPACITATING CHEMICAL AGENTS

The line of distinction between incapacitating chemical agents and riot control agents is one generally drawn on the basis of the duration of effects. Incapacitating agents have been defined by the U.S. Army as "an agent that produces temporary physiological or mental effects, or both, which will render individuals incapable of concerted effort in the performance of their assigned duties." This definition can be contrasted with the U.S. Army definition of a riot control agent as "an agent that produces only a temporary irritating or incapacitating effect when used in field concentrations." See also riot control agent in this glossary for a definition provided by the Secretary of State during hearings on the Geneva Protocol.

JOHNSTON ISLAND

A storage site in the Pacific, about 715 miles SW of Honolulu. Nerve agent munitions and bulk quantities of the herbicide Agent Orange are stored on this island as are other munitions. West Germany is also known to have stockpiles of U.S. nerve agent munitions.

LIMITED RETALIATION

One of the arguments for the retention of a chemical warfare retaliatory capability is, in the words of the Honorable John O. Marsh, Jr., Assistant Secretary of Defense, "it provides the President an option of limited retaliation below the nuclear threshold in the event chemical weapons were used against U.S. forces." Hearings, Armed Services Committee, H.A.S.C. No. 93-28, October 3, 1973. p. 12.

NBC

An acronym used to refer to nuclear, chemical and biological warfare. Since the U.S. no longer has an offensive biological warfare program, the term is used only infrequently. Foreign literature frequently uses this acronym in discussions of "weapons of mass destruction."

NERVE AGENTS

These are colorless, odorless organophosphates which may enter the body either through inhalation (in a gaseous form) or through absorption through the skin. They act by interfering with the transmission of nerve impulses to muscles and rapid death from convulsions and respiratory paralysis can occur. The two standard U.S. agents are GB and VX. GB is more volatile than VX; VX is more toxic. See the Scientific American article by Matthew Meselson for more detail. These nerve agents are in U.S. stockpiles in bulk storage containers, artillery shells, bomblets, spray tanks and other munitions.

"NO FIRST USE"

The United States publicly stated CW policy is that this country will not be the first to use CW weapons in a war but that we reserve the right to retaliate in kind if attacked with chemical weapons by any other nation.

OPERATION RED HAT

This is the code name assigned to the project for the relocation of nerve agents from stockpiles on Okinawa to Johnston Island in the Pacific. The project is complete.

ORGANOPHOSPHOROUS COMPOUNDS

A class of organic chemicals to which the chemical warfare nerve agents belong. See GB and VX for additional information. This same class of general compounds includes certain insecticides such as parathion and malathion - among the more toxic to humans of the large group of insecticides.

PICLORAM

One of the herbicides used in Vietnam. Useful for destroying woody plants and deep rooted perennial weeds.

PINE BLUFF ARSENAL, ARKANSAS

The Army arsenal at this site (near Little Rock) has been designated as the probable location of the production facility for the binary artillery shell which the Army proposes to manufacture. Commercial contractors would provide the second chemical ingredient to be added to the munition upon actual use. A section of Pine Bluff had been used for the biological warfare production but this section was turned over to the Food and Drug Administration and is now being used as the National Center for Toxicological Research (NCTR is separate from the Pine Bluff Arsenal).

PROJECT EAGLE

The code name for the disposal of chemical agent mustard and the nerve agents munitions at Rocky Mountain Arsenal, Denver.

PROTOCOL

When this term is used, it generally has reference to the Geneva Protocol of 1925 - a treaty on the prohibition of the use in war of chemical and biological warfare agents. It should be noted

that another treaty, also before the Senate Foreign Relations Committee for advice and consent to ratification, is known as the BW Convention - or a more comprehensive prohibition of research, development, production and stockpiles of biological weapons.

RDT & E

This acronym stands for research, development, test, and engineering - the project phases through which a weapon passes before reaching production. The binary chemical artillery shell now near production is in test and engineering. Other munition types and new chemical agents are in various other phases of development. Project listings for FY 73 are found in Congressional Research Service Report 72-264SP, pp. 21-28 and in the copy of the Congressional Record for March 11, 1974, pp. S3333-S3348 provided in the reference materials.

RETALIATORY POLICY

The United States has enunciated a policy, by President Roosevelt as well as by President Nixon, that the U.S. will not initiate the use of chemical weapons in war but that this country reserves the right to retaliate with CW if attacked by any other Nation with these types of weapons.

RIOT CONTROL AGENTS

A definition offered by Secretary Rogers during the first Senate hearings on the Geneva Protocol of 1925 was: " riot control agents are those of a type which are widely used by governments for law enforcement purposes, because in all but the most unusual circumstances, they produce transient effects that disappear within minutes after removal from exposure." The extensive use of the riot control agent known as CS in Vietnam produced the charge by many observers that the U.S. was conducting chemical warfare in Vietnam. The President has indicated that riot control agents are not included in the Geneva Protocol of 1925 thus emphasizing that they are not chemical warfare agents regulated by the Protocol. See Congressional Research Service Report 71-261SP, pp. 23-25 for a pro-con analysis of excluding riot control agents from the Protocol.

STORAGE SITES -CHEMICAL AGENTS

According to statements by the Secretary of the Army, there are chemical agents and munitions in storage in the States of Alabama, Kentucky, Colorado, Utah, Oregon, Maryland, Indiana, and Arkansas, as well as overseas at Johnston Island and in Germany. The agents are of three types: (1) WWI mustard, (2) GB, and (3) VX. Filled

munitions include artillery shells, rockets, land mines, and rocket warheads.

TERATOGENIC

This is a term used to refer to birth defects. In the context of chemical warfare, the herbicide 2,4,5T used in Vietnam, is suspected of being a teratogen. As a minimum, a contaminant known as dioxin, found in 2,4,5T is established as a teratogen in certain animal species.

TRANSPORTABLE DISPOSAL SYSTEM

The U.S. Army is developing a multipurpose transportable system for the destruction of obsolescent chemical munitions. This system is being developed in order to permit destruction on site rather than moving surplus toxic munitions from one site to another.

VX

The code name for one of the U.S. Army's chemical warfare nerve agents. See also GB and the article by Matthew Meselson provided in the reference materials, pp. 18-19. VX is less volatile than GB, thus is more persistent and can contaminate in liquid as well as gaseous form. VX also is more toxic than GB.

VERIFICATION - CHEMICAL DISARMAMENT

A major obstacle to the development of a CW arms control treaty which would restrict or eliminate RDT & E as well as production and stockpiling is the difficulty in securing agreement on acceptable techniques to insure compliance with a treaty. Three approaches seem possible: technical inspection (on-site); economic monitoring (study of the flow of raw and intermediate materials which could be used to make chemical warfare materials); and intelligence activity. It now appears that some combination of all of these techniques may be required. There is no agreement on any technique as yet - and there is great resistance to the most reliable technique - on-site inspections.

"WEAPONS OF MASS DESTRUCTION"

Soviet training is generally directed toward the entire complex of nuclear, chemical and biological warfare. Since so much of the defense equipment and training is similar for all three weapon systems, it is frequently difficult to precisely identify which weapon system the Soviets may be referring to in their tactical training. Soviet terminology refers to all three weapons systems, chemical, biological, and nuclear as "weapons of mass destruction."

Study Entitled "A Vaccine Against Organophosphorus Poisoning,"[1] April 1972

Ludwig A. Sternberger, Van M. Sim, William G. Kavanagh, John J. Cuculis, Howard G. Meyer, David E. Lenz, and Dennis M. Hinton, Biomedical Laboratory, Edgewood Arsenal, Maryland

Effectiveness of a vaccine against organophosphorus poisoning requires that it evoke quantities of antibodies specific for the agent. Importantly the average specific binding affinity per antibody molecule must be high to insure that the poisonous agent binds with the antibody more rapidly than with the normal target of poisoning, namely cholinesterase.

A foreign molecule, when injected, will be recognized selectively by a few lymphoid cells possessing on their surface specific antigen recognizing units. Some of these specific lymphoid cells in further processes elaborate information that will tell other cells whether to produce specific antibodies or suppress the formation of specific antibody. If the former occurs we say our injected molecule is immunogenic; if the latter occurs we say it is tolerogenic. To produce a good vaccine against organophosphorus poisoning we had to modify the organophosphonate molecule to make it more immunogenic than tolerogenic. We used fundamental information initiated by other immunologists many years ago and perfected more recently in several laboratories (1). Two things are necessary. The first is to increase the molecular size of the specific antigen, organophosphorus. This is accomplished by coupling it covalently to a large molecule such as a protein which we will call "carrier." The second requirement is the use of a protein carrier which in itself embodies antigenicity in excess of tolerogenicity. After many years of trial we have now selected the protein carrier as well as the system for conjugation of agent to carrier which yields large amounts of antibodies with highly binding affinity in every animal injected and which consequently protects every animal against exposure to the agent. We will discuss only this system.

The agent is the organophosphonate E600 (paranitrophenyldiethylphosphate). Its formula is in the upper right hand corner of figure 1. To make an antigen the agent is coupled to a protein. To this end the nitro group is reduced to the amine resulting in a nontoxic compound. Among the various choices for coupling with amine to protein the only one that gave a regularly good antigen was diazotization followed by coupling into protein tyrosine at ratios of 3 to 15 molecules of agent per 150,000 molecular weight units of protein. The only regularly effective protein carriers have been purified lobster hemocyanine and aggregated bovine gamma globulin, each having a molecular weight in excess of 4 million.

The antigen or vaccine so produced (table I) was given to rabbits in 3 or 4 intravenous injections. This was not the optimal way of animal immunization but we have chosen it as the only one practical in a human population. Despite this, using the properly prepared antigen, we obtained a specifically precipitating antibody response in excess of 100 μg nitrogen per ml in each rabbit injected. Furthermore each rabbit possessing this antibody was fully protected against 2 to 4 intramuscular LD50's of the agent E600. By full protection we mean that the animal was entirely asymptomatic after exposure to agent. Control rabbits of course had convulsions in each case and were dead within the hour.

Thirty-one weeks after the last injection of antigen the level of circulating antibody had waned to below detectability. Nevertheless, upon exposure to 4 LD50's of agent, such rabbits lived longer than unvaccinated controls.

[1] For a more explicit and up-to-date discussion, see "Immunocytochemistry", by Ludwig A. Sternberger, Prentice-Hall, Inc., Edgewood Cliffs, N.J. 07632 (1974).

Immunologic prophylaxis differs from that obtained with oxime and atropine in several respects. Oxime-atropine prophylaxis, while sometimes preventing death, will not prevent the patient's symptoms. He will be very sick indeed, hardly able to cling to life. Immunologic prophylaxis prevents all symptoms from agent. There is reason to believe that an exposed patient would never know that he had been exposed.

Oxime-atropine prophylaxis is only effective if high blood levels of these compounds are obtained. Because they are eliminated by the body, these drugs must be given at a predictable instant prior to an enemy attack. Immunization on the other hand protects for a long time and therefore prediction of the time an enemy attack will occur is not necessary.

The data show that immunization is a predictable, effective and simple prophylaxis so long as antibody production is successful. According to our experience it is successful once we find the best mode of conjugation and the best carrier. We have not yet found these in the case of agent GD. The right lower part of figure 1 gives the formula of GD. For immunization the nitrophenyl analog of GD was produced bearing a nitrophenyl group instead of the fluorine. The compound was reduced and coupled into carrier protein tyrosine via diazotization as shown in figure 1, or conjugated with protein lysine with carbodiimide. So far immunized animals have not been protected against GD. This failure has nothing to do with the toxicology of GD but has been clearly correlated with a low antigenicity of the vaccines we have produced until now, resulting in only minimal levels of circulating antibodies.

TABLE I

Group (3 rabbits per group)	Antigen 880 moles agent derivative/mole hemocyanin 10–30 mg/kg iv	Exposure to E600 (subcutaneous)	Average time to death after exposure
E_1	3 x at 25 to 30 day intervals	2 x LD50 (1 week after 3d antigen)	No ill effect.
Control		2 x LD50	14 min.
E_1	4 x at 25 to 30 day intervals	3 x LD50 (1 week after 4th antigen)	No ill effect.
Control		3 x LD50	55 min.
E_1	4 x at 25 to 30 day intervals	4 x LD50 (31 weeks after 4th antigen)	107 min.
Control		4 x LD50	45 min.
E_2	4 x at 21 day intervals	4 x LD50 (1 to 3 weeks after 4th antigen)	No ill effect.
Control		4 x LD50	73 min.

Note: Protected animals not only survived but, in contrast to other modes of prophylaxis, had no ill effect from the agent.

If a human population is immunized one cannot monitor the effectiveness of immunization by resistance to agent exposure because of the danger involved. Instead one has to measure two parameters. One is the level of circulating antibody in terms of antibody nitrogen. The other is the average intrinsic association constant of these antibodies, which is a measure of their binding strength and clinical effectiveness. The amount of antibody is being monitored by the use of agent coupled to bovine serum albumin. This antigen is reacted with antibody, the resulting complex removed by ammonium sulfate precipitation and the residual supernatant antigen assayed spectrophotometrically. For measuring the average binding strength of antibody, in one approach, purified antibody is needed. Anti-E600 has been purified by removing antibody from serum with agent covalently bound to a derivatized dextran column and eluting the antibody with an excess of agent. Agent is then removed from purified antibody by exhaustive dialysis. When varying amounts of agent are added to known amounts of purified antibody the ratio of free to bound antibodies depends on the average intrinsic association constant. The amount of bound agent was measured by quenching of the fluorescence of the purified antibody. Free antibody absorbs light maximally at 280 nanometers and emits the energy at about 350 nanometers. Agent E600 absorbs at 350 nanometers and hence, when bound in the antibody molecule, quenches its fluorescence emission. The average intrinsic association constant of purified anti-E600 was found to be 5×10^5 and its heterogeneity index 1.0. This indicated surprisingly weak binding and superior homogeneity. We concluded that dialysis failed to remove all the agent from antibody during purification and that purification in itself selected antibodies of low binding strength.

To obviate the need for purified antibody and the incumbent selection of binding properties, we prepared agent coupled to tyrosine and reacted the

product with ^{125}I. Equilibrium dialysis against an IgG fraction of antiserum permitted evaluating bound radioactivity counts in a system that does not require purified antibody. The average intrinsic association constant was found to be higher than 10^{10} and the heterogeneity index about 0.6, comparable to the highest binding strength systems known to immunology. The protective effect of the antibodies produced by immunization is thereby explained.

The antibodies and the immunity evoked are specific to the agents used. There is little cross-reactivity with other organophosphates. This of course is the expected result and is a corollary of high binding activity and clinical effectiveness. Immunization has thus become an effective new principle for phophylaxis against organophosphonate poisoning. The procedure is independent of oxime resistance of the agents and in any event it is more effective than previous attempts at prophylaxis against organophosphonate poisoning. Therefore, the major problem at this time is not effectiveness, but safety. Although no rabbit has died as a result of immunization, we must realize that clinical vaccination is not given to a few rabbits but to thousands of people. It is imperative that none of them has acute or chronic side effects from the vaccine.

Our present vaccines not only evoke antibodies to the agent, but even more so to the carrier protein. Repeat injections of vaccine will form carrier antibody complexes capable of causing immune complex nephritis, a chronic and fatal disease in man. Even though in animals under experimental conditions only transient immune complex nephritis has been produced, followed by complete recovery upon cessation of injection of antigen, we cannot assume that in a patient with subclinical lupus erythematosus or subclinical and hence unrecognized nephritis, immunization will not precipitate a progressive lethal syndrome. The proper avoidance of this potential, delayed complication is the design of vaccines that produce high agent and low carrier immunity. This requires the simultaneous and independent variation of two factors, each difficult to optimize, and hence not measurable by the single analysis of success of random immunization in a limited number of animals. Instead, a test to predict the response with different agent carrier combinations must be developed. Recent work by Benaceraff's group (3,4) and by others (5) has shown that in the ligand carrier response a different cell may recognize the carrier and the ligant specificities and that both cells cooperate towards the function of a mature antibody-producing cell. To study this cooperation on a large scale we cannot wait until cells actually have produced measurable amounts of antibody. Instead we should be able to trace the process in an earlier stage by checkerboard titration and to predict the kinds of antibodies to be produced as a result of in vitro admixtures of cells recognizing varying carriers and varying agent derivatives. To this end we must be able to map antigen receptors on the surface of the immunocompetent cell. We must also be able to map nascent antibody and its specificity on the surface and in the interior of the cell slated to become an antibody-producing cell. Essentially, this is a requirement for an immunohistochemical method which is sensitive and specific enough for recognition of antigenic determinants within a single molecule and for quantitatively enumerating single molecules. Methods that use antibody conjugated with a detector, such as fluorescein or ferritin, did not possess the requirement (6). Hence, we introduced a new principle for immunohistochemistry in which only native, unlabeled antibodies are employed and in which the antigen antibody reaction on electron miscroscopic tissue sites is amplified by an enzymatic detector (7–15).

In figure 2 we have depicted the antibody molecule in its familiar "Y" shape in which the fragments bearing the specific combining sites are drawn in bold lines. There are two such fragments in each molecule; hence, two specific combining sites. Tissue antigen is first reacted with specific antiserum produced in a suitable species such as a rabbit. Since diluted antisera usually are used the antibody combines with the tissue antigen via both of its combining sites. In the second step sheep antiserum to rabbit antibody is applied in excess. The rabbit antibody is now the antigen, and since the sheep antibody is used in excess, only one of its combining sites reacts with the rabbit antibody and the other combining site remains free. Next, purified soluble antigen-antibody complex is applied, consisting of peroxidase and rabbit antibody to peroxidase. This rabbit antibody is, however, also an antigen to the sheep antibody already attached to the tissue and hence the complex will bind specifically. The enzyme is then localized electron microscopically by its substrates, hydrogen peroxide and diaminobenzidine, followed by omiscation of the polymeric enzyme product. By this mechanism an enzymatic reaction for peroxidase affords amplification

to the detection of the single rabbit antibody molecule initially attached to the tissue.

We also introduced a procedure for making purified soluble peroxidase-antiperoxidase complex (8) (figure 3). It depends on precipitating antiperoxidase from antiserum with peroxidase, redissolving the precipitate at acid pH in a moderate excess of peroxidase, and separating complex from free peroxidase by ammonium sulfate precipitation. It turned out that the complex consisted of three molecules of peroxidase and two of antiperovidase and that it was pentagonally ring shaped. Extensive physical chemical studies on the complex have shown it to have the dimensions indicated in figure 3 and have also explained the stability of the 3:2 circular bonds which exceed those of antigen-antibody complexes of other specificities.

The next few figures demonstrate that this method indeed reveals single antigenic sites, thus permitting quantitation (16).

If upon progressive dilution of reagents in an immunohistochemical procedure the intensity of visualization of a site becomes progressively fainter, the method is not very sensitive. If the method is sensitive it is the number of reacting sites that decreases while the intensity per localized spot remains unaltered. This is exactly what happened with the new method, now called the unlabeled-antibody enzyme method. Thus, when antiserum is progressively diluted the probability increases that each discrete spot represents the amplified deposit corresponding to a single molecular site in situ.

Figure 4 shows what happens when antiserum to sheep red cells is applied to the cell followed by the unlabeled antibody enzyme method. The concentration of the antiserum was 1/50th of that required for saturation of the cell surface as demonstrated with radio-labeled antibody and by enzymatic assay. Nevertheless the total cell surface was specifically localized as a continuous stain.

When serum is progressively diluted localization becomes discontinuous only after dilutions in excess of 1/5,000th the saturation concentration. For the preparation shown in figure 5, the concentration was 1/500,000th of the saturation concentration. Localization of a single molecule per cell section is evident. In fact there was only one molecule per two sections, or 69 molecules per cell.

By this method we can thus estimate relative numbers of single molecules on different subcellular sites. In order to express results in absolute numbers it is necessary to correlate the data at low concentration which yields discrete localization with data at saturation concentrations. To this end a novel nephelometric method for measurement of peroxidase activity was developed (12). The method is so sensitive that we can estimate specific enzyme activity per localized molecule at the low level of antibodies where single molecules can be discerned in the electron microscope. This is beyond the sensitivity of measurement with radioisotope-labeled antibody. At the same time specific enzyme activity can be measured at higher levels of antibody at which antibody also can be measured by radioactivity. This level is too high for counting single molecules by electron microscopy. Correlation of both specific activities permits expression of electron microscopic data in terms of absolute numbers of molecules.

Our own application of the unlabeled antibody enzyme method concerns the separate detection and enumeration of organophosphonate and of protein carrier molecules in bone marrow-derived thymus-derived and other antigen-decognising lymphoid cells. Lymphocytes are being separated for this program in zonal gradients and the specific receptor-bearing cells within the fractions identified histochemically. Cells from receptor bearing fractions are then mixed and early formation of antibodies in culture is again monitored histochemically.

Meanwhile our unlabeled antibody enzyme method has found a range of applications in other laboratories. These include cancer research, virology, blood coagulation research, embryologic differentiation, transplantation, hormone secretion, hormone effects, and plant physiology.

Immunization against nerve agents constitutes the first instance that vaccination against a synthetic chemical, not occurring in nature, has been found to be pharmacologically effective. It is hoped that immunohistochemically monitored refinements will make the procedure clinically safe.

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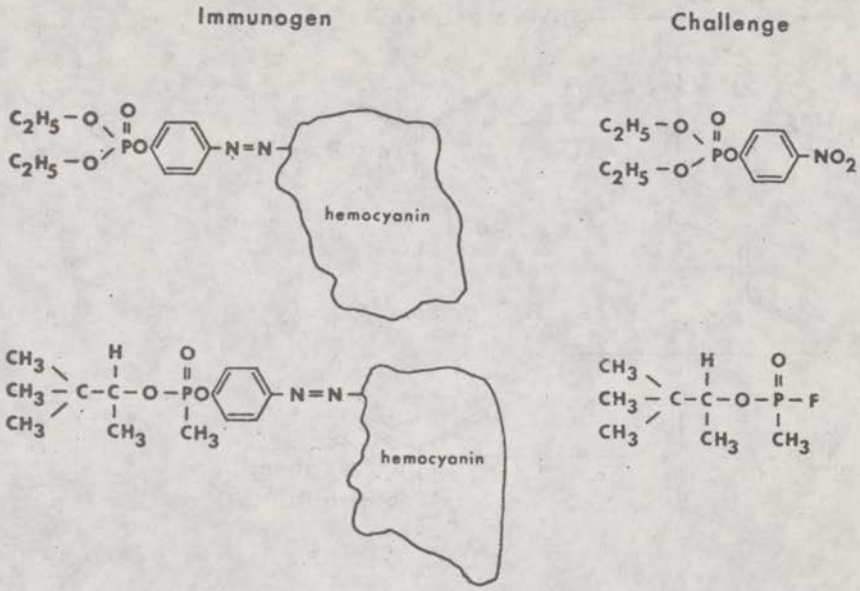

FIGURE 1.—Diazotized Agent (Analog)-Protein Conjugates Compared to the Agent.

(Upper) Azo-P-Aminophenyldiethylphosphate-Hemocyanin Compared to Paraoxon

(Lower) Azo-P-Aminophenylmethylpinacolyl-phosphonate-Hemocyanin Compared to GD

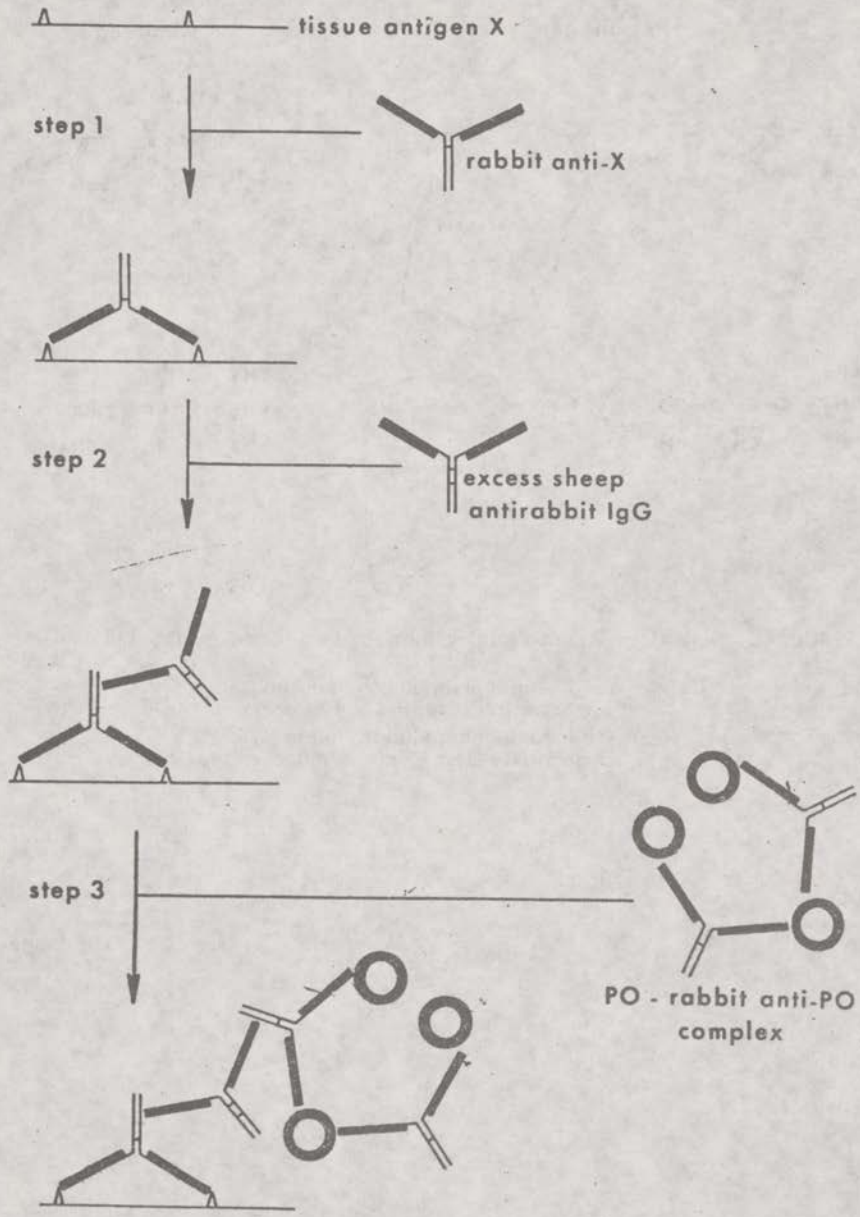

FIGURE 2.—Sequential Application of Reagents in the Unlabeled Antibody-Enzyme Method of Immunohistochemistry.

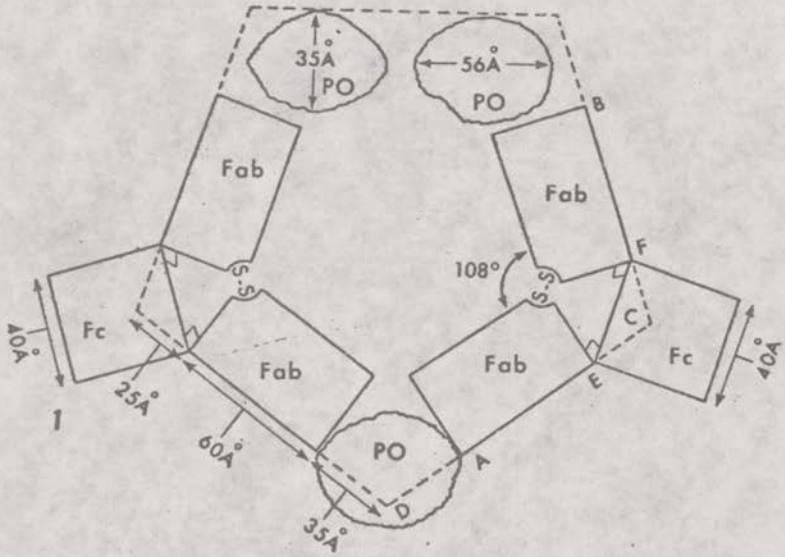

FIGURE 3. – Peroxidase-(Rabbit) Antiperoxidase Complex (PAP).

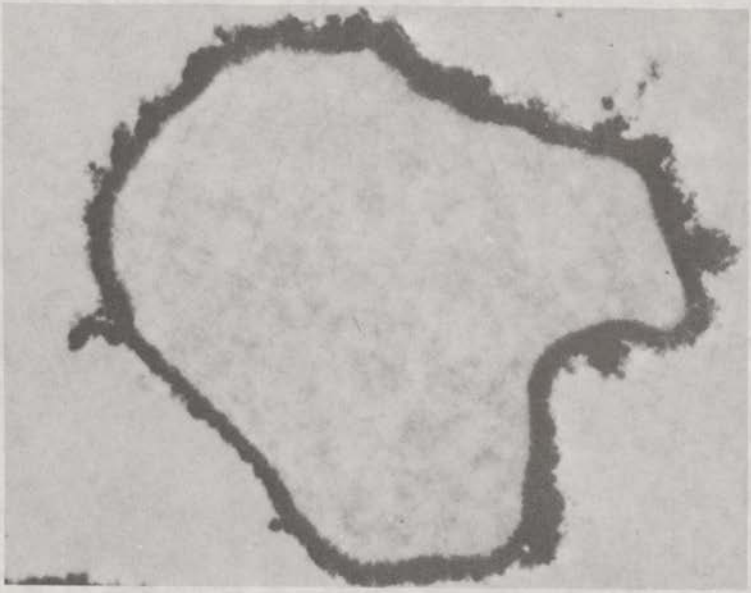

FIGURE 4.—Electron Micrograph of a Sectioned Sheep Erythrocyte Stained by the Unlabeled Antibody-Enzyme Method Using a 1:50 Dilution of Antiserum.

FIGURE 5.—Electron Micrograph of a Sectioned Sheep Erythrocyte Stained by the Unlabeled Antibody Method Using a High Dilution (1:500,000) of Antiserum.

The Effects of Herbicides in South Vietnam

PART A – SUMMARY AND CONCLUSIONS

Committee on the Effects of Herbicides in Vietnam
Division of Biological Sciences
Assembly of Life Sciences
National Research Council

National Academy of Sciences
Washington, D.C.
1974

NOTICE

The project which is the subject of this report was approved by the Governing Board of the National Research Council, acting in behalf of the National Academy of Sciences. Such approval reflects the Board's judgment that the project is of national importance and appropriate with respect to both the purposes and resources of the National Research Council.

The members of the committee selected to undertake this project and prepare this report were chosen for recognized scholarly competence and with due consideration for the balance of disciplines appropriate to the project. Responsibility for the detailed aspects of this report rests with that committee.

Each report issuing from a study committee of the National Research Council is reviewed by an independent group of qualified individuals according to procedures established and monitored by the Report Review Committee of the National Academy of Sciences. Distribution of the report is approved, by the President of the Academy, upon satisfactory completion of the review process.

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The Committee on the Effects of Herbicides in Vietnam. Division of Biological Sciences. Assembly of Life Sciences. National Research Council.
The Effects of Herbicides in South Vietnam:
Part A. Summary & Conclusions.
Wash., D. C. National Academy of Sciences

1974 1-21-74

ABBREVIATIONS USED IN THIS REPORT

ARVN	Army of the Republic of Vietnam
CINCPAC	Commander in Chief, Pacific
CORDS	Civil Operations and Rural Development Support
DOD	Department of Defense
DRVN	Democratic Republic of Vietnam
HERBS	Acronym for computerized records of herbicide spray programs
HES	Hamlet Evaluation System of CORDS
JUSPAO	Joint United States Public Affairs Office
MACV	Military Assistance Command, Vietnam
MR	Military Region
NAS	National Academy of Sciences
NLF	National Liberation Front
NVA	North Vietnamese Army
RVN	Republic of Vietnam
RVNAF	Republic of Vietnam Armed Forces
SVN	South Vietnam
USAID	United States Agency for International Development

NATIONAL ACADEMY OF SCIENCES

OFFICE OF THE PRESIDENT
2101 CONSTITUTION AVENUE
WASHINGTON, D. C. 20418

February 15, 1974

The President of the Senate
The Speaker of the House of Representatives
The Secretary of Defense

Sirs:

I have the honor to transmit the report of the National Academy of Sciences on the effects of the program of herbicide spraying in South Vietnam. This report was prepared pursuant to Public Law 91-441 of 1970.

As the ability of organized societies to destroy each other by military means has escalated, it has become increasingly necessary to attempt to limit warfare to the actual combatants and the accomplishment of immediate military objectives. To these ends, international agreements have been directed, for example, to humane treatment of prisoners of war, respect for hospitals, recognition of military medical personnel as noncombatants, and avoidance to the extent possible of all but truly military targets. Thus, also, has our government agreed to eschew the use of biological and chemical weapons.

To be sure, given the intrinsic irrationality of war, if flame-throwers, high explosive weapons, laser-guided bombs, and all the rest are deemed to be "acceptable," one may reasonably ask how one can rationalize outlawing any other weapon or procedure on the ground that it is still more inhumane? Nevertheless, just as men of good will, in all nations, agree that a principal burden upon governments is to utilize diplomacy and negotiation -- rather than arms -- to settle differences, so, too, are they agreed that governments must continue to press for international agreements which, to the extent possible, will limit military actions to the achievement

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of immediate military ends, minimizing all other associated brutality, horror and destruction of the natural and man-made worlds. Indeed, it is the difficulty in thus containing the effective dimensions of nuclear weapons which has rendered their use so abhorrent that they have become weapons of last resort. And it was such concerns, inter alia, that led to the present study.

The more commonly used herbicides are synthetic chemical analogues of the hormones that, in the normal developing plant, regulate its rate and pattern of growth. Because of their specificity -- causing aberrant growth or death of some plant species while without effect on others -- these herbicides have found wide use in agriculture and home gardening. Indeed, the American capability to feed ourselves and also provide 70 percent of all of the food surplus, anywhere on the planet, which now can be made available to feed those in less fortunate nations, derives in significant measure from the use of this same class of chemicals.

In the course of the war in Southeast Asia, these herbicides were utilized on a large scale for military purpose, predominantly for defoliation of dense forest so as to permit detection of enemy military and supply units, and to lesser degree for crop destruction and a variety of other purposes. The general procedure was to dispense solutions of herbicides from fixed-wing aircraft or helicopters so that a fine spray would envelop the vegetation below. As the magnitude of this program increased, thoughtful individuals considered it desirable to inquire into the acute and persistent effects, if any, of such herbicide usage on the Vietnamese population as well as on the fauna and flora of the region. Presumably, the findings of such an examination could (a) contribute to the assessment of damage to Vietnam which will be required to plan future efforts to reconstruct that country and repair the ravages of war, and (b) assist in judgment as to whether, in the future, such herbicide usage should be considered to fall within or outside the category of chemical warfare to be eschewed, as defined in the Geneva protocols.

As an expression of this concern, the Congress, in Public Law 91-441, directed that:

> (1) The Secretary of Defense shall undertake to enter into appropriate arrangements with the National Academy of Sciences to conduct a comprehensive study and investigation to determine (A) the ecological and physiological dangers inherent in the use of herbicides, and (B) the ecological and physiological effects of the defoliation program carried out by the Department of Defense in South Vietnam.
>
> (2) Of the funds authorized by this Act for research, development, testing, and evaluation of chemical warfare agents and for defense against biological warfare agents, such amounts as are required shall be available to carry out the study and investigation authorized by paragraph (1) of this subsection.

On 26 October 1970, by a letter addressed to the Director of Defense Research and Engineering, the Academy accepted this responsibility. The Academy has a long tradition of scientific assistance to the national defense and it desires also to be of whatever assistance it can in furthering our ability to minimize the undesirable secondary consequences of warfare without sacrificing the capability of the American military establishment to assure the national defense. Hence, with the understanding that the resultant report to the Department of Defense and to the Congress would be made public, we were pleased to accept this task. Contract DAHC15 71 C 0211 between the Academy and the Department of Defense, to provide funds and other support for this endeavor, was signed on 8 December 1970.

Arrangements for the study: As we entered upon the task, some of its inherent difficulties were self-evident: Appraisal of the effects of herbicide usage, necessarily, had to be undertaken well after the fact. Since the war in South Vietnam was certainly not conducted as a controlled experiment, valid conclusions might well be seriously constrained by the complexity of actual circumstances, by lack of adequate records or qualified observers on the scene at

the time of the spraying program. Patently, separation of the effects of herbicides from all other aspects of the war would be difficult at best. Most importantly, military activity was and still is continuing in most of the areas which had previously been sprayed with herbicides; accordingly, safe access to large areas of the country was denied to our field teams, thereby in no small measure frustrating their efforts to secure critical data. Indeed, several of our Committee now know the sensation of being in an airplane subjected to fire from the ground.

The present report was prepared by an especially appointed ad hoc Committee on the Effects of Herbicides in Vietnam, working, administratively, within the Division of Biology and Agriculture of the National Research Council. Each member of the Committee was especially selected for his specific technical competencies. Professor Anton Lang of Michigan State University, a member of the Academy, renowned plant physiologist and authority on plant hormones accepted the invitation to chair the Committee. A deliberate decision was taken to enroll, as full-fledged members of the Committee, a number of scientists from countries other than our own. A distinguished Vietnamese scientist, Professor Le-Van-Thoi, President of the National Scientific Research Council of Vietnam, agreed to serve as Associate Chairman; other members are from South Vietnam, Canada, England and Sweden.

The early planning for this study indicated the desirability of including, on the Committee, one or more appropriately qualified anthropologists. However, formation of the Committee was significantly delayed when anthropologists indicated their reluctance to be associated with this effort because the supporting funds were to be provided through the Department of Defense, an attitude formalized by the American Anthropological Association. A meeting to resolve this question, arranged by the Division of Behavioral Sciences of the National Research Council, was attended by several senior anthropologists, albeit not as formal representatives of the American Anthropological Association. Subsequently, one senior anthropologist undertook to serve without any qualifying reservations, while another agreed to participate provided that the funds to be utilized in support of his specific activities, within this project, would derive from some source other than the Department of

Defense. Concerned that the study be neither unduly delayed nor seriously incomplete, the use of private funds from the endowment income of the Academy was authorized for this purpose.

When the study began, it was recognized that much of the basic information concerning herbicide usage in South Vietnam was classified by the Department of Defense and not available to the public. In an exchange of correspondence on this subject, the Defense Director of Research and Engineering indicated that:

> ...I would like to assure that all information which may be required in its conduct will be supplied by the Department of Defense regardless of classification.

Subsequently, he wrote that:

> This acknowledges your letter of 26 October recommending declassification of DoD data on herbicides for use by the National Academy of Sciences study.
>
> ...I agree that your committee must have access to these data and that they should be declassified. However, premature release of these data, and their subsequent partial evaluation and publication by either scientists or journalists prior to publication of your study, would not be in the best interests of either of us. I suggest that the data should be restricted to the use of your committee until your report is published. At that time the data could be placed in the public domain....

Later, in a letter concerned with various detailed arrangements for the study, I stated that:

> ...It is further understood that the Department is prepared to make available on a privileged but otherwise non-classified basis all information and data in its possession directly related to the matters under consideration as well as

full access to various civilian and military personnel whose particular experience and information may be considered necessary in the development of the study program....

On this basis, without requirement for security clearance of those Committee members who had not previously undergone clearance for other reasons, the work was undertaken.

The present report is only a summary of the full activities and findings of the Committee; a more complete account will be made available as soon as possible. This summary report has been subjected to an unusually intensive review by an ad hoc panel of Academy members appointed by our Report Review Committee. In a constructive dialogue, the authors of the report responded to numerous questions, suggestions and criticisms of the review panel.

Findings and Conclusions of the Report -- A Commentary.

The report provides its own summary and recommendations. It may, however, be of assistance to the reader to comment upon some of the principal findings of the report and their significance.

1) The Committee was unable to gather any definitive indication of direct damage by herbicides to human health. However, to a greater extent than in other areas, there were consistent, albeit largely "secondhand," reports from Montagnards, of acute and occasionally fatal respiratory distress, particularly in children. The inability of the Committee to visit the Montagnards in their own locales so as to verify these tales, is greatly regretted. Although these reports did not come from medically qualified observers, the Committee considers it to be important that this matter be pursued at the earliest opportunity.

Considerable attention was paid to the possibility, suggested previously, of birth defects induced by herbicides or by contaminants in herbicide preparations; no evidence substantiating the occurrence of herbicide-induced defects was obtained. However, the potentially most definitive aspect of this examination has not yet been completed.

x

2) Attempts to assess the social, economic and psychological effects of the program of herbicides spraying on the peoples of South Vietnam were less than satisfying. Certainly the impact of the spraying program on that population now appears relatively trivial as compared with other aspects of the upheaval in that country. Evidence was obtained that numbers of families moved away from their traditional homes because of the herbicide spray program, but few were actually identified. The fertility of their land, however, was not reduced thereby and it should not be residual effects of the crop destruction program, per se, which prevents their return. On the other hand, small land holders growing tree crops, e.g., coconuts, definitely suffered more lasting economic damage.

Other than the belief reported to be prevalent among the Montagnards that spraying was directly responsible for acute illness, by and large the South Vietnamese appear to hold no consistent views with respect to alleged health hazards resulting from exposure to herbicide spraying, although many are greatly concerned with this possibility. Only in part did such fears as were expressed appear to find their origin in propagandistic activities.

Although available toxicological information had indicated that, within a considerable dosage range, the herbicidal compounds are relatively innocuous, no sizeable human population had previously been thus exposed. Moreover, at the time the program began, it was not known that preparations of the herbicide, 2,4,5-T, were contaminated with the extraordinarily toxic compound, TCDD (2,3,7,8-tetrachlorodibenzo-para-dioxin), about 200 to 300 pounds of which, mixed with about 50 million pounds of 2,4,5-T, were dispensed over South Vietnam. That no serious sequelae have since been definitely discerned is fortunate indeed. However, the continued presence of possibly significant concentrations of this material in fish in inland rivers, taken as recently as 1973, is considered to be a matter that warrants further attention.

On balance, the untoward effects of the herbicide program on the health of the South Vietnamese people appear to have been smaller than one might have feared.

3) The effects of herbicides on vegetation were largely confined to those resulting from direct contact during spraying. It was found that the various herbicides

disappear from the soil at a rate sufficiently rapid as to preclude any significant effect on the next crop of food plants, or on the next growing season of trees, shrubs, etc.

All evidence indicates that standing food crops, of all sorts, were highly vulnerable to the spray program. It was not possible, however, to assess the nutritional consequences of that program on the affected local populations.

4) A major effort of the Committee was devoted to appraisal of the effects of the herbicide spraying program on the forests of South Vietnam.

a) The mangrove forests were found to have been extremely vulnerable. One spraying resulted in the death of virtually all exposed trees, in this case, about 36 percent of the entire mangrove forest, equal to about 0.6 percent of the entire area of South Vietnam. It is estimated that these forests will not spontaneously recover for well nigh a century, if at all; reforestation by a program of massive planting of seedlings could reduce the time required to about two to three decades.

Concomitant with this devastation has been a significant reduction in the more valuable fauna of the waters of the region; however, several other changes appear to have been contributory at the same time, and it is difficult to know how significant the death of the mangroves was to this process. The dead mangroves are being harvested for fuel now, as in the past, although this occupation supports fewer individuals today than before the war. The economic loss, therefore, will be sustained in the future, when the forest has been stripped, unless a vigorous replanting program is undertaken. If this is not done, mankind will have been guilty of a large and ugly depredation of our natural heritage.

b) The bulk of the herbicide spraying program was addressed to the large inland forests of South Vietnam; of the total of about 25.9 million acres of such forests, at least 10.3 percent (6.5 percent of the total land area of South Vietnam) was subjected to one or more sprays. Unfortunately, for lack of military security, this area could not be examined on the ground by the Committee.

The appraisal of herbicide effects in the inland forests, therefore, necessarily rested virtually entirely upon interpretation of aerial photography, some of which was already available but most of which was obtained at the request of the Committee. Unfortunately, photointerpretation of damage to an essentially unfamiliar forest is extremely difficult; quantitative estimates may be accepted as reasonably reliable only if an acceptable sample can also be checked on the ground. Although no such opportunity was available, the Committee had no other alternative.

No other aspect of these studies engendered difficulty and controversy as did the estimate of damage to the inland forests. The original approach to this question was to appraise the damage in terms conventional to professional forestry, viz., the volume of "merchantable timber" represented by standing dead "merchantable trees," i.e., trees of such size and quality as to have been candidates for timbering by the commercial practices of the region. Assessment was undertaken in these terms because a) it limits the assessment to the larger trees, more readily identified by aerial photography, b) such an assessment might make possible an estimate of economic loss, and c) preliminary estimates, in these terms, had already been published. Trees which have disappeared are not counted by this procedure and standing trunks of large trees which have lost much of their crowns may be difficult to identify. However, dead trees of the commercially more valuable species commonly stand for several years before falling.

When the initial estimate, in these terms, proved to be strikingly smaller than previously reported preliminary estimates by others, it encountered scientific incredulity among members of both the working Committee and the Report Review panel and engendered, in varying degree, an antagonism which was conditioned by the turbulent emotions which are the legacy of the American experience in the Vietnam war. While the latter situation lasted, it hindered progress of the study by focusing attention on this single parameter. For months, it diverted attention from full appreciation of the fact that such a summarizing, overall figure can be truly meaningful only if a single spraying were uniformly damaging, as it is to the mangroves, and from appreciation

that such a figure cannot reveal differential effects of one spraying as compared with multiple sprayings, differential effects on different types of forest, or on the merchantable trees as compared either with the growing stock or with trees of non-merchantable quality -- were there any such differential effects.

The resultant challenges to the estimate ultimately proved useful. Intensive rescrutiny of the data by the Committee resulted in significant upward revision of the quantitative estimate of damage and directed attention to the differential effects that the report now emphasizes. The report reveals that the Committee now considers that multiple sprayings will be devastating to any forest, as it was to these, and that even a single spraying can be very serious in relatively open forest and lethal to forests of particularly susceptible species. It remains possible that the Committee's estimate of the gross kill of merchantable timber will prove to be significantly lower than reality; if so, that will certainly be meaningful, but it no longer seems to be the central question. The extent and nature of total damage to the forest cannot adequately be expressed by this single statistic.

Meanwhile, months of intensive discussions, joint inspections of photographic material, refinement of procedures and of calculations, challenges and rebuttals were required in order to erase suspicion and relieve discord. To the extent that there remains concern for the accuracy of the Committee's estimate of the loss of merchantable timber in the inland forest (see below), that concern should now rest solely on scientific grounds. This painful episode is recounted in further evidence of the multitudinous, sometimes subtle effects of the Vietnam war on the American people.

The Committee's final estimate of the total volume of merchantable timber in standing merchantable trees killed by herbicides in the inland forest is about 1,250,000 m^3, i.e., within a range of from 500,000 to 2,000,000 m^3, out of a total stock of "merchantable timber" in the sprayed area estimated to be about 8,500,000 m^3. The records are known to underestimate the total sprayed area; both estimates are, hence, understated proportionally.

When the fact of the disparity between the Committee's original estimate and previous estimates was recognized, a team of three independent photointerpreters and forestry experts was invited to review the procedures which had been used and to make an independent appraisal of the total damage to the inland forests, utilizing the photographic materials available to the Committee. Their estimate, based on a necessarily limited examination of the available material, was of the order of the top of the range now reported by the Committee. However, one member of this group, after a second examination of the photographic material suggested that the loss of merchantable timber may be a few times greater than that here reported by the Committee. In addition, a member of the Report Review panel has informed his colleagues that, also utilizing some of the materials gathered by the Committee, he estimates the amount of merchantable timber in the trees killed by herbicides in the inland forest to be significantly greater even than that estimated by the independent consultant. He has been invited to publish his analysis in the open literature.

The differences among these estimates arose from differences in the actual counts of dead trees in a given sample area, the specific samples used and the validity thereof, the total volume of merchantable timber assumed to have been in the forest before the spraying, etc. It may be noted that the sample areas examined by the Committee were decidedly larger than those utilized in formulating the other estimates and that the Committee gave considerable attention to weighing the relative contributions of those areas which had been sprayed zero, once, twice, thrice, or four or more times. However, it is not clear to what extent these differences contributed to the differences among the results. Patently, definitive resolution of these substantial differences will not be possible until an appropriate survey of the area can be made on the ground.

It is not clear, in any case, what social, economic or ecological significance to impute to the estimated parameter, i.e., the volume of "merchantable timber" killed by the spraying. As long as the dead trees stand, they do not necessarily represent "economic loss" since, were peace restored, there would still be opportunity to timber many of these trees, provided that the necessary

labor and mill capacity were available. Similarly, trees killed by herbicide spraying that have disappeared because they were taken down for timber or fuel do not represent economic loss.

Accordingly, the Committee sought other indicators of the extent of damage to the forest. Several other observations by the Committee seem more descriptive of the consequences to the forest of the spraying program than is the absolute value assigned to the volume of merchantable timber killed by herbicides:

i) Two-thirds of the area sprayed in the inland forest was sprayed only once. The dead merchantable trees in such areas, in excess of those expected from normal mortality, were found to be rather variable and generally few in number. The impression was gained that most of these areas, particularly in the dense forest, will spontaneously recover in due course, with the distribution of species probably much as it was before.

ii) The number of dead merchantable trees per unit area increased with multiple sprayings. Areas sprayed three or more times were extremely hard hit; in some areas more than half of all "merchantable trees" were killed. These areas, perhaps 12 percent of the total sprayed area, are unlikely to recover without a major effort at assistance.

iii) The bulk of the biomass in much of the forest consists of non-merchantable trees, viz., trees below merchantable size (growing stock) or of non-merchantable quality. When killed, these trees generally decompose and disappear much more rapidly than do "merchantable trees." Although quantitative estimation of damage to this component of the forest biomass is not feasible by aerial photography, the Committee notes that the loss of such material due to herbicide spraying was extensive in relatively open forest and less serious in the dense, heavily canopied forest; as a very rough approximation the Committee suggests that the loss of such material may have been of the order of 5 to 13 million m^3. The report further notes that:

> One clear conclusion reached by the Committee is that the greatest damage which the inland forests suffered from war activities, including herbicides, has been incurred by the heavily overused open or

thin forests and by the young secondary forests emerging from abandoned swidden. This damage does not appear in the assessment of merchantable timber loss since it represented loss of growing stock below merchantable size and of the early stages of forest regeneration. In these forests the loss of seed sources may be a very critical factor even though the merchantable volume of lost seed trees was quite small. High mortality of seedlings, saplings and young trees, not reflected in merchantable timber loss, in many cases resulted in setting the succession back for many years. But this loss, though very real, could not be quantitatively evaluated without far more extensive studies on the ground than those we were able to conduct.

...Damage due to bombing and shelling, whether or not it was associated with herbicide treatment, may well be the most serious and long lasting of all of the war impacts on the inland forest. In the large areas cleared by bombings, not only the merchantable timber, when present, was destroyed but so was all of the growing stock in the opening. Extending far beyond the dimensions of the opening in the forest created by the bomb strike is the damage to living trees caused by shrapnel. These metal fragments in the living trees have already created serious problems for the manufacturers of forest products in SVN in terms of equipment maintenance, loss of yield, reduction in mill productivity and serious hazards to the operating personnel, and these problems will persist long after the residual effects of herbicide damage have disappeared. These problems may indeed reduce the opportunities to sell South Vietnamese logs in the international market and to establish new wood-using industries in SVN....

...Future development of a viable forestry program in SVN, including forest management and development of utilization facilities, will have to be based upon study of the unusual conditions induced by war damages, separately and in combination. Areas where growing stock has been depleted and where regeneration has been inhibited will need to be given special treatment to restore productivity. The longer the delay in taking these measures the more difficult and costly will be the rehabilitation.

Thus, whereas one cannot rationally assign some dollar value to the herbicide-caused economic loss to Vietnam, either in the past or the near future, there will be serious penalties in the long term unless a commensurate effort is undertaken to prevent them. And, as in the case of the mangroves, there is the burden of conscience to restore these forests to their natural or improved condition.

The Academy is grateful to the Committee, its staff, its consultants, and our reviewers, all of whom gave unstintingly of themselves in the major effort herewith reported.

This highly informative report cannot, by itself, provide definitive answers to all of the questions held by the Congress at the time of passage of Public Law 91-441. However, considering the adverse circumstances under which it was prepared, we consider the report to be a most significant accomplishment. We trust that it will prove to be a meaningful contribution to understanding and a useful guide for future decisions.

Respectfully yours,

PHandler

Philip Handler
President

NATIONAL RESEARCH COUNCIL

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February 11, 1974

Dr. Philip Handler, President
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Dear Dr. Handler:

I am herewith transmitting to you the summary report of the Committee on the Effects of Herbicides in Vietnam.

When, almost exactly three years ago, I agreed to direct this study as Committee chairman, I questioned whether the study of one particular impact of the war in South Vietnam would be very productive. It was clear even then that the country had suffered from many war related disturbances and that the effects of such would be closely intertwined; to disentangle one effect would neither be easy, nor provide a comprehensive assessment of the consequences of its use.

My concern over the feasibility of this assignment was deepened with my first visit to South Vietnam. It became very clear at that time that the accounts which we had been given of the improved security and safety situation, while perhaps quite true for cities and larger settlements, did not apply to outlying areas--especially the mangrove and inland forest--which had been exposed to the heaviest herbicide sprayings and which therefore we needed to visit and study in detail. I accepted your appointment despite these handicaps because of my belief in the importance of determining the nature and scale of these effects and because the longer the assessment might be delayed, the lesser became the prospects of obtaining meaningful data. I believe these feelings were shared by all those who accepted appointment to the Committee.

The limitations within which the Committee had to work necessitated some profound and often agonizing revisions in our plans; agonizing in that we often had to accept less than ideal alternatives, whether in regard to the extent of a study or the techniques utilized. There was one principle that was maintained on which I and the members of the Committee from the outset had placed the greatest importance: our studies must be approached in a quantitative manner. However, the extent to which a problem could be so studied under these conditions varied greatly. An inventory of the herbicide operations--what fraction of the various vegetation types had been sprayed, and

how many times--was done for the whole country. Damage to inland forests was assessed on a substantial and representative sample. Impact on settlements was studied in 18 areas reaching from the southernmost tip of the country to the latitude of the City of Hue in the north. Other studies could be done only in one or a few selected sites, and generalizations, if any, made only with strong qualifications. In some important problem areas, our results did not permit any conclusions. This quantitative approach, although it limited the extent of problems which could be studied, was preferable to collecting a larger quantity of qualitative, anecdotal data inasmuch as these latter would not have permitted <u>any</u> generalizations.

To the extent possible in a study of this nature, all results and conclusions are documented by data. However, the supporting material gathered by the Committee is voluminous and is both quantitative and qualitative. Much of it is in the form of working documents prepared by individual Committee members and/or consultants and will be submitted for publication in the near future. It should provide further opportunities for study and analysis by others who may follow.

To my regret, it has not been possible to obtain a consensus of all Committee members on all sections of this report. Professors Pham Hoang Ho, Alexander Leighton, and Paul Richards have disassociated themselves from the section dealing with the quantitative assessment of damage to the inland forests (IV B 3). Their statements of exception are reproduced in a section immediately following the text of the report. I respect their exceptions although I believe the assessment of forest damage was conducted by individuals with great experience and an impeccable record in forest surveys of this nature. I must add that this study was very complex indeed and spans a very wide spectrum of disciplines. Therefore, the individual members of the Committee should not be held accountable for every part of the entire report.

In presenting this report I wish to recognize and commend to you the enormous contribution of the members of the Committee. They remained dedicated even when it became necessary to scrap or alter study plans, and although all were engaged with other pressing commitments they never refused to place at our disposal their time, their thought, or their personal convenience. The consultants and associates of the Committee also deserve highest praise, as does the Committee staff and especially the Committee's principal staff officer.

Respectfully,

Anton Lang

Anton Lang
Chairman

xx

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The Effects of Herbicides in South Vietnam

SUMMARY

Origin of the Study (Section I)[a]

The study had its origin in the widespread public concern that the extensive use of herbicides in the Vietnam war may have had serious adverse effects, perhaps irreversible, on environment and people, major economic losses because of damage to forests and crops, and reproductive failures, congenital malformations, and genetic damage in humans.

In response to this public concern, Congress in late 1970 directed the Department of Defense (DOD) to contract with the National Academy of Sciences (NAS), for a study of the ecological and physiological effects of the widespread military use of herbicides in South Vietnam (SVN). A 17-member committee, with additional professional staff and 30 consultants, carried out the study, which included field, laboratory, and library research. Some 1,500 man-days were spent in SVN during the course of the study, the results of which are discussed in the following report. Additional technical details are available in the public records of the Committee.

The Committee conducted work on the following:

1. Inventory of the sprayed areas by herbicide type, date, and frequency of spray application as related to vegetation types and to population density.

2. Effects on vegetation, with emphasis on the inland and mangrove forests--the two vegetation types subjected to the most extensive herbicide spraying--and also with consideration of effects on crop production.

3. Persistence of herbicides in the soil, and their effects on soil fertility, i.e., on the content of essential nutrients available to plants.

4. Effects on animals (limited to studies on animal populations in estuaries, and on the populations of disease vectors, both in the mangrove).

5. Effects on people (medical, socioeconomic, psychological).

The extent to which these problems could be effectively dealt with was highly variable. The Committee could construct only a tentative initial program; this had to be modified repeatedly in the course of the work. The principal limitation to the Committee's work was the security conditions in SVN, which rendered long-term field studies virtually

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[a] Section numbers refer to sections in the body of this report.

impossible. Moreover, the Committee started its work in SVN in September 1971, while all major herbicide operations were terminated early in that year; the Committee had somewhat over one year for gathering most of its materials. Hence, on the one hand, relatively short-term effects were difficult to study; on the other hand, except where detailed historical information such as aerial photographs were available, research was limited to short periods of time, whereas some of the effects, for example on succession of vegetation in forests, are long-term ones. Statistics and inventories on SVN population, forestry, and agriculture were not available or did not contain sufficient detail to allow quantitative assessments of many herbicide effects, particularly at the national level. Despite these limitations, we carried out field studies on a number of problems (effects on vegetation and soils, persistence of herbicides in soils, effects on estuarine life and on ecological-epidemiological effects of defoliation, and on the perception of herbicides and their effects by humans), and the available documents, including extensive aerial photography, were examined and evaluated.

History of Military Use of Herbicides in South Vietnam (Section II B)

The military use of herbicides in SVN began in 1962, was greatly expanded in 1965 and 1966, and reached a peak in 1967-69 (see Table I). After it was reported that 2,4,5-T, one of the components of the most extensively used herbicide preparation, Agent Orange, caused birth defects in mice, the use of this agent was stopped in 1970, and, during 1971, application of herbicides under U.S. military control was rapidly phased out. According to records available to the Committee, fixed-wing operations ceased in 1971, and other applications in October of that year. The herbicide agents used in the Vietnam war and the application rates are shown in Table II.

The Herbicides Used in the Vietnam War (Section II C)

The herbicides used for military purposes in SVN are among a considerable number of chemical compounds utilized widely for the control of weeds and unwanted vegetation, although the application of some of them, in the United States and some other countries, is limited to specific purposes. They are selected because they can be manufactured cheaply and in large quantities, but also for physical, chemical, and biological characteristics that minimize undesired side effects. They have been used worldwide in large quantities, on the whole without causing serious hazards. There is considerable information on their properties, such as solubility and volatility, effects on plants, behavior in soil, toxicity on and behavior in animals, although the amount of this information is greater for some (2,4-D and 2,4,5-T) than for others (picloram, cacodylic acid).

In the form present in Agent Orange, 2,4-D and 2,4,5-T are little soluble in water but are moderately volatile. In soil, they undergo rapid breakdown (2,4-D more rapidly than 2,4,5-T). These properties indicate that the two compounds will not readily move in soil and water, though some movement as vapor does occur. 2,4-D in the form present in Agent White, and the other component of this agent, picloram, are non-volatile

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Table I.

Application of Herbicides in the Vietnam War by Year

Millions of Gallons

Year	1962-July 1965	Aug-Dec 1965	1966	1967	1968	1969	1970	1971	Total
Orange	NA[a]	.37	1.64	3.17	2.22	3.25	.57	.00	11.22
White	NA[a]	0	.53	1.33	2.13	1.02	.22	.01	5.24
Blue	NA[a]	0	.02	.38	.28	.26	.18	.00	1.12
Total	1.27	.37	2.19	4.88	4.63	4.53	.97	.01	18.85

[a]Not available.

Table II.

Herbicides Used in SVN 1965-1971

Agent	Active Chemical Components	Military Application Rate (lb/acre)	Millions of gallons used, Aug. 1965-1971
Orange	2,4-D	12.00	
	2,4,5-T	13.80	11.22
White	2,4-D	6.00	
	Picloram	1.62	5.24
Blue	Cacodylic acid	9.30	1.12
Total			17.58

but highly water-soluble, and picloram is more persistent in soil than 2,4-D or 2,4,5-T. Thus, while there is no hazard of movement in vapor form, there is some hazard of movement with water, both in soil and by rain. Cacodylic acid, the active component of Agent Blue, is also non-volatile and water-soluble but decomposes rather rapidly to non-soluble, relatively non-toxic aresenical compounds in soil and water.

2,4-D, 2,4,5-T, picloram, and cacodylic acid are distinctly toxic but only when ingested or absorbed in relatively large amounts. The toxicity of 2,4-D and 2,4,5-T is somewhat greater than that of picloram and cacodylic acid. 2,4-D and 2,4,5-T are rapidly excreted in unchanged form by most animals, and there is no evidence for accumulation in any tissues or in the food chain. Some derivatives of the two herbicides, including those present in Agent Orange, seem, however, to possess a relatively high toxicity for some aquatic animals.

In 1969, both 2,4-D and 2,4,5-T were reported to produce birth defects in laboratory animals. At about the same time, it was recognized that 2,4,5-T contained a contaminant, TCDD (2,3,7,8-tetrachlorodibenzo-para-dioxin), an extremely toxic material that also possessed teratogenic properties. However, whereas some of the birth defects in laboratory animals, which had originally been ascribed to 2,4,5-T, were actually caused by TCDD, it appears that 2,4,5-T has some teratogenic potential of its own, although at relatively high doses. Tests with 2,4-D were less conclusive.

TCDD, a Contaminant of 2,4,5-T (Section II C-2, C-5)

TCDD is extremely toxic to some laboratory animals. In male guinea pigs, the most sensitive animal so far found, a single dose of 0.0006 milligrams per kilogram body weight causes death in half of the animals fed. In other animals (rats, mice, rabbits) the corresponding dose is considerably higher, in the range of 0.05 to 0.2 milligrams per kilogram. TCDD has been found to be teratogenic in mice; results with other laboratory animals have not been conclusive. The lethal dose in humans is not known, nor is that required to cause birth defects, if indeed there is such an activity. TCDD is strongly implicated as the main cause of chloracne, a disease that has affected employees in some plants manufacturing 2,4,5-T or its precursor, 2,4,5-trichlorophenol. TCDD apparently decays very slowly under normal environmental conditions, indicating that its potential hazards may be very persistent.

Inventory of the Military Use of Herbicides in South Vietnam (Section III)

The Committee conducted as thorough as possible an inventory of the herbicide operations in SVN, as the basis for assessing the effects of these operations on vegetation, soils, and people. The main source used was the HERBS tape, a computerized record of time, place, amount, type, and military purpose of herbicide operations carried out by aircraft between August 1965 and February 1971 (plus a printout covering the period

March through October 1971, the stated termination of the U.S.-controlled herbicide operations). The material, which covers about 85 percent of all herbicide operations in SVN, was evaluated in conjunction with the help of a vegetation map and aerial photographs in order to determine the distribution of herbicides with respect to vegetation types. Their distribution with respect to population and to settlement types in the whole country could not be studied, because relevant material was received too late. Results of such studies in selected areas are summarized under "Human Reactions to Military Use of Herbicides," Items 1-3, see below.

The number of gallons sprayed in SVN is shown in Tables I and II, the areas sprayed once, twice, and more times in Table III. The total area of SVN that was sprayed is somewhat larger than the area of Connecticut, while the entire country (approximately 44.6 million acres) equals in size this state plus Rhode Island, Maine, Vermont, New Hampshire and Massachusetts.

About 88 percent of the herbicide missions recorded on the HERBS tape were designated for defoliation, about 9 percent were for crop destruction, and the remaining 3 percent were directed at base perimeters, enemy cache sites, waterways, and lines of communication. There was little relationship between recorded purpose and distribution of sprays with respect to native vegetation type, although a relatively greater proportion of the crop-destruction missions employed Agent Blue, and all these missions were flown in the northern two thirds of SVN. Regardless of the stated purpose of the mission, about three quarters of the total gallonage was sprayed over inland forests, about 8 percent over mangrove forests, and a little over 7 percent over permanently cultivated areas (see Table III). Crops were affected, however, to a greater extent than indicated by the latter figure because temporary fields ("swiddens") such as those customarily cultivated by the Highlanders (Montagnards) were classed as "forest," and because field crops were damaged by drift of herbicides outside the intended or recorded spray path.

Herbicide Damage to Vegetation (Section IV)

Death of and damage to vegetation caused by herbicides can have many different consequences: loss of potential production at a stage before the growth becomes economically valuable; loss of commercial products such as timber, grain and fruit; lack of young plants and of seeds necessary to maintain the "system," the latter type of effect being particularly important in native vegetation. The Committee studied herbicide damage to three major vegetation types of SVN: the inland forest, the mangrove forest, and (permanently) cultivated land. Information on effects on the last-named type (crop damage) was obtained mainly in a study of effects on settlements and by interviews with villagers, and the results are therefore reported under "Effects of Herbicides on Humans." With the exception of extensively sprayed mangrove forests, aerial photographs showed that vegetation cover of some type returned to most areas within six months to a year after they had been sprayed. Because of limited access to the

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Table III.

Estimated Acreage Sprayed One or More Times, 1965-1971[a]

Vegetation Type[b]	Total in SVN in 1953		Number of Times Sprayed Aug. 1965-Mar. 1971				Total Sprayed one or more times	
	Millions of acres	Percent	Millions of acres				Millions of acres	Percent
			1	2	3	4+		
Inland forest	25.91	62.4	1.72	0.62	0.22	.11	2.67	10.3
Cultivated land	7.80	18.8	0.20	0.04	0.01	0.00	0.26	3.2
Mangrove forest	.72	1.7	0.14	0.07	0.03	0.02	0.26	36.1
Other	7.07	17.1	0.31	0.07	0.02	0.00	0.39	5.5
Total	41.50	100.0	2.37	0.80	0.28	0.13	3.58	8.6

[a]Does not include coverage of missions before August 1965 (1.27 million gallons) and missions after that date for which location information is incomplete (1.1 million gallons), representing about 12.5% of the total gallonage accounted for. Compare Tables III C-1 and III C-2, and related text.

[b]Inland forests include those areas classed as dense forest, secondary forest, swidden zones, bamboo forests, open dipterocarp, Lagerstroemia and Leguminosae forests. "Other" include pine forests, savanna and degraded forests, grasslands and steppes in higher elevations, dunes and brushland, grass and sedge swamps and areas of no vegetation (urban areas, roads, water courses, etc.). Classification and area figures follow Bernard Rollet (1962). See Tables II-E and III B-3 and the accompanying text.

forest we were often not able to determine the exact nature of the post-spray vegetation. The fact that vegetation of some type generally returned promptly suggests, however, that there was no permanent inhibition of plant growth because of adverse conditions in the soil.

Inland Forests: Damage and Redevelopment (Section IV B[1],[2])

The inland forests received three-quarters of all herbicide sprays. As a result of extensive study of aerial photography and limited observations on the ground in sprayed forests, we conclude that damage to forests depended on the frequency with which a given area was sprayed, the time intervals of individual sprays in multiple-sprayed areas, the extent to which there was other disturbance (especially bombing, and also clearing and burning for agriculture or other purposes, as well as selective logging). It should also be noted that much of the inland forests of SVN, including the areas sprayed with herbicides, was already disturbed--as are most tropical forests, except those in the remotest locations--by lumbering, agriculture clearing, or fire prior to the time of spraying. Although some areas are technically classed as "forest," and have been subjected to herbicide sprays, they contained few large trees.

Because so many variables are involved, the extent to which there will be recovery from deleterious effects, and the time required, cannot be stated in precise terms. In some areas, particularly those sprayed only once and not subject to other disturbances, damage was generally limited to the tallest trees, which were more exposed to the spray than lower ones. It appears that redevelopment will resemble the pattern of forest growth following harvest of large trees. In areas sprayed more frequently, where damage was heavier in the lower stories of the forest, the redevelopment will take longer. If large-scale rehabilitation of war-damaged inland forest is undertaken, it is probable that all single-sprayed and most multiple-sprayed forests can eventually be restored to productive forestry by adopting appropriate silvicultural practices. Systematic on-the-ground studies of sprayed areas are essential, with special attention to numbers and sizes of young individuals of the important tree species and of seed sources.

Concern has been expressed that herbicide-damaged forests will be replaced by bamboo. Information derived from limited field and aerial reconnaissance suggests that where herbicide spraying has led to the death of the forest tree species and suppression of their reproduction, bamboos, if present in the area--as they are in many but not all inland forest areas--tend to increase with establishment of pure stands, which may persist for many years. However, it is difficult to distinguish this herbicide effect

from effects of other disturbances, particularly fire and agricultural clearing, and it should be realized that extensive bamboo forests existed in the SVN before the herbicide operations, probably as results of such disturbances. Evidence for rapid invasion of new forest areas by bamboos as a consequence of herbicide spraying was not observed.

Inland Forests: Loss of Merchantable Timber and Other Damage
(Section IV B-3)

Using the HERBS records of herbicide operations, plus aerial photographs taken before, during, and after these operations, combined with information on the characteristics of the forests of SVN and measures of logs used currently in sawmills in SVN, the Committee estimated the total loss of merchantable timber in SVN forests by estimating the total number of trees of merchantable size killed by the herbicide operations in the inland forests of SVN, based on a detailed analysis of no less than some 100,000 acres (40,000 hectares). The estimate is 1.25 million m^3 with a range of 0.5 to 2.0 million m^3. This may be related to an estimated total of about 8.5 million m^3 of merchantable timber in the sprayed area. Our estimate is, however, much lower than previous estimates by some other authors. The reasons for this discrepancy lie in differences in assumptions about the status of the forest inventory in SVN prior to application of herbicides, in estimates of effect of one and more than one spray, in predictions of length of time for restoration of forest structure following spray, and differences in estimates of total forest area exposed to herbicide sprays.

Loss to non-merchantable timber in the herbicide-sprayed area of the inland forests was estimated to be between 5,050,000 and 11,150,000 m^3 (see Table IV B-8) although the accuracy of this estimate is considerably less than that for merchantable timber.

In addition to the losses in merchantable and non-merchantable timber, there are other types of damage; to saplings and young trees ("growing stock" which in normal forest development will replace older trees as these die or are harvested, to growth because of herbicide damage (e.g., loss of part of the crown), which however did not result in death, and to seed sources. These damage classes could not be determined quantitatively, because of lack of both access on the ground and a forest inventory. However, the damage to growing stock has been substantial, particularly in heavily overused open forests and in young forests emerging from abandoned swidden. Loss of seed sources in these forests may also be a very critical type of damage, with serious consequences for the future of the forests, even though the merchantable volume of the source trees (per unit forest surface) was quite small. Thus, the total damage, particularly in multiple-sprayed inland forest areas, was undoubtedly extensive and serious. We also found some, although not very extensive, anomalies for which the explanation is not clear. These were usually areas that had been sprayed four times and from which the tree cover has almost entirely disappeared. The reasons for this could not be determined. Other areas sprayed as many or more times did not exhibit this much damage.

Damage to the inland forests was not confined to herbicides. Damage by bombing was also heavy, in both extent (area) and intensity (destruction of all trees, large and small, in the area of the crater, heavy damage in its perimeter, including metal fragments embedded in surviving trees, which pose a hazard in sawmills, etc., and may reduce the value of timber from SVN in general).

Damage and Regrowth in Mangrove Forests (Section IV C)

A large proportion of the mangrove forests was sprayed with herbicides, and was more heavily affected by the spraying than any other vegetation type in SVN. Of the approximately 720,000 acres of SVN that were covered by mangrove (representing about 1.7 percent of the total area of the nation), about 260,000 acres, or 36 percent, were sprayed. One spray usually killed all mangrove trees; large contiguous areas were devastated, and there has been little or no recolonization of mangrove trees in extensive sprayed areas, except along the margins of some of the canals that drain these swamps. One reason for this is that in some areas, especially the "Rung Sat Special Zone" southeast of Saigon, the destruction of this vegetation type was so complete as to eliminate most seed sources. Wood cutting, a traditional economic pursuit in the mangrove forests, is probably further reducing the supply of seeds and retarding recovery. An estimate based on a model suggests that, under present conditions of use and natural regrowth, it may take well over 100 years for the mangrove area to be reforested. With a massive reforestation program, the forest could probably be restored in approximately 20 years if sufficient money and seed resources were available.

The mangrove forest plays important roles as spawning site and food source for many economically important fish and shellfish species. Comparative studies of frequency of fish, shellfish, and planktonic organisms--the last-named important as food for the former two--in waters of an herbicide sprayed and largely denuded region and of an intact mangrove region showed that, while both were rich in planktonic organisms, the numbers and variety of these organisms were lower in the former than the latter. The same was true of large fish, while fish eggs and larvae were more frequent in the denuded region, although the variety of fish was the same. However, the data are not extensive, and the differences between the two sites are not large enough to draw firm conclusions. Overall fish catch in SVN has not changed much in the years of the herbicide operations, but catch per fishing craft (per unit of effort) has declined, in contrast, for example, to the situation

in Taiwan and Thailand. However, it was not possible to separate the operation of herbicide-related effects, such as the possible decrease in fish food, from other effects, such as increased fishing pressure, increased motor boat traffic, and decreased safety.

Effects of Herbicides on Soils (Section V)

The Committee conducted two kinds of studies to investigate the possibility that military applications of herbicides might have resulted in long lasting changes in the ability of the soil to support plant growth. First, samples of soil from sites in SVN and Thailand that had been sprayed during the military herbicide operations or in related tests were chemically analyzed for the presence of herbicides (2,4,5-T; 2,4-D; picloram). Second, planting experiments and chemical analyses for residual herbicides were conducted in SVN and the Philippines in tropical forest, agricultural, and mangrove soils that had been treated with herbicides in the same amounts as used in the herbicide operations in SVN. In general, both chemical and biological assays showed that toxic residues of herbicides applied at military rates disappeared within less than one year. If traces persisted (in certain mangrove areas), they were below or near the limit of biological activity even in highly sensitive plants and did not seem to affect the reestablishment of native vegetation.

Limited studies were made of soil fertility--that is, the contents of the soil in readily available essential plant nutrients--in herbicide sprayed and unsprayed inland and mangrove forest areas. Compared with other ecosystems, in tropical forests a very high proportion of those plant nutrients is contained in the vegetation, rather than being retained in the soil. Concern has therefore been expressed that the death of large amounts of tropical forest vegetation may lead to loss of essential nutrients from the ecosystem, decreasing the prospects for revegetation after extensive herbicide treatment. Our results indicate, however, that although there were certain differences between "sprayed" and "unsprayed" inland forest and mangrove soils, the widespread death of vegetation caused by the herbicides has not had lasting detrimental effect on those plant nutrients within the ecosystem, with the possible exception of potassium. Potassium may be lost especially if the levels of other elements in the soil or the shed plant matter should become too high.

We saw no evidence in aerial photographs, aerial observation, or our limited visits to affected forests that destruction of vegetation by herbicides had resulted in laterization (permanent hardening of the soil surface, which inhibits forest regrowth) over any large areas of inland forests, as has been suggested by some authors.

Effects of Herbicides on Humans (Section VII)

The following conceivable types of herbicide effects on animals and humans were considered by the Committee: toxicity in directly exposed

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individuals; birth defects of offspring born to exposed mothers; ecological effects on disease-carrying insects and rodents; economic and behavioral changes associated with herbicide-caused destruction of vegetation; and perception and evaluation of herbicide effects by the Vietnamese public.

Herbicides and Birth Defects (Section VII A-1)

The Committee could find no conclusive evidence of association between exposure to herbicides and birth defects in humans. Available records of two major Saigon hospitals and evaluation of records in a third, as far as they go, showed no consistent pattern of association between rates of congenital malformations and annual amounts of herbicides sprayed. The Committee recognizes however that the material is not adequate for definite conclusions.

The Committee has not yet completed its comparison of herbicide-spray records with the dates and places of birth of children with birth defects who were treated at the Barsky Unit, Cho Ray Hospital, Saigon-Cholon. The Barsky data are probably the best ones that can be obtained in SVN for the study of the problem.

The TCDD Problem in South Vietnam (Section VII A-2)

Analyses of samples of Agent Orange that had been returned from SVN, or had been procured but not shipped to the country, indicate that the amounts of TCDD ranged from less than 0.05 to almost 50 parts per million, with average concentrations in two sets of samples of 1.91 and 2.99 ppm. Over 10 million gallons of Agent Orange were used in SVN, suggesting that perhaps 220 to 360 lb of the TCDD contaminant were released over SVN.

Until early 1973, there were no analytical techniques available with sensitivity and specificity sufficient to detect the extremely small quantities of TCDD likely to be present in the environment. A much more sensitive and specific analytical method for detecting TCDD has recently been developed, and it has been reported that TCDD is present in fish and shellfish collected in 1970 and 1973 in waters of SVN, which drain areas that had been subjected to heavy herbicide sprays during the war. While the significance of this finding is by no means clear, it has raised serious, legitimate concerns for the public health; these concerns will persist as long as the problem is not resolved.

Herbicides and Medical-Ecological Changes (Section VII A-3)

Insect and rodent carriers (vectors and reservoirs) of human diseases are sensitive to small changes in the environment that they may share with humans. The Committee studied differences between vector populations and the prevalence of malaria in human populations living in cleared and uncleared mangrove forests. Malarial mosquitoes were absent and there was no malaria among children living in uncleared mangroves in Thailand. Malaria organisms were found in the blood of 7 percent of children in a herbicide-cleared mangrove area in SVN, where mosquitoes of species known to be capable of transmitting malaria were also found. A

mechanically cleared mangrove area in Thailand had malarial mosquitoes, and also had a higher rat population than did uncleared mangrove areas in Thailand. The results of this study led the Committee to conclude that clearing of mangroves by mechanical or chemical means may lead to environmental changes that favor vectors of human diseases. In the cleared mangrove community in SVN, the presence of malaria was probably a consequence also of temporary or permanent migrants from previously malaria-infested areas, and of the development of irrigated agriculture in herbicide-cleared areas that previously had been used for woodcutting and fishing.

Human Reactions to Military Use of Herbicides (Section VII B, C)

The Committee studied human reactions to the military applications of herbicides by interpretation of aerial photographs taken before and after spraying of a variety of land use and settlement types, by interviews, and by examination of relevant local documents where available. Studies of one or more of these kinds were conducted in mangrove forest, irrigated rice, coconut plantation, gardening, and upland crop areas, and among Vietnamese and Montagnard peoples (the latter being interviewed in refugee camps). We also made a study of Saigon newspapers and other publications representative of the urban population. The results of aerial photography, documentary, and interviews were highly consistent, thus reinforcing one another. On the other hand, the opinions obtained in interviews in each community were quite diverse, suggesting that our respondents were usually expressing their own perceptions of herbicides, rather than following propaganda lines of either the government of RVN or the NLF. Following are the main general results:

1. Some communities and agricultural areas of all land-use types that we studied were in the direct path of recorded herbicide missions, many of them repeatedly. However, since the areas were selected because they had been heavily sprayed, these results cannot be used for a quantitative estimate of people thus affected in the country as a whole.

2. Herbicide spraying resulted in the displacement of people from their homes and contributed to the urbanization of SVN. However, major dislocations of human populations that followed herbicide sprays were often associated with other types of aerial or ground military activity. In only one out of 18 areas studied did population and settlements increase over the pre-spray period.

3. Application of herbicides in areas of human habitation resulted in destruction of or damage to crops regardless of the intended military purpose and the herbicide agent used. In 16 out of 18 areas studied, crop damage that had been caused by missions designated as defoliation was greater than that by missions designated as crop destruction. In addition to crop damage because the fields were in the direct flight path of herbicide missions, there was evidence for widespread crop damage by drift, i.e., herbicide carried outside the intended target area by wind, even though herbicide missions were not to be flown when wind velocity exceeded a certain limit.

4. Herbicide exposure of field crops usually resulted in loss of production for no more than one growing season. There was no evidence that crops could not be replanted within one year and less after the last herbicide spray. Fruit trees, especially coconuts, jackfruit, and papaya, suffered more persistent damage, and in some cases were killed, leading to loss of production for several years. Damage reparations--which, however, were intended on a solatium basis--were generally inadequate to pay for the direct damage in a single year, and did not even attempt to pay for lost production beyond the year of the spray, nor for the costs of restoring production. The loss was probably greatest to those farmers who were closest to the margin of subsistence and to those heavily dependent on tree crops.

5. Some individuals in every community in which people were interviewed reported that domestic animals and humans became ill or died after exposure to herbicide sprays, or after eating herbicide-treated plants or drinking contaminated water. Toxic symptoms reported included eye, skin, respiratory, and digestive disturbances. Reports of serious illness and death, especially among children, were more common and consistent among the Montagnards than among the lowland people. No independent medical studies of exposed populations were however in either case available from the time of spraying against which these reports could be confirmed or refuted.

6. Effects of herbicides were preponderantly viewed as deleterious to the livelihoods of the people whose land was sprayed, with the exception of some residents of the mangroves, who thought that defoliation resulted in increased security from the NLF, and also made it easier to clear land for irrigated fields. Woodcutters in this area recognized, however, that their primary resource had been largely eliminated by herbicides.

Psychological Reactions to Herbicides (Section VII B-2)

The study of psychological reactions among South Vietnamese consisted of two types of investigations: (1) measurement of emotional strain and (2) assessment of attitudes about herbicides. Refugees from a rural community which had been heavily sprayed showed a higher level of emotional strain than any other group to which they could be compared. Among them, those who had experienced the larger number of hard knocks of war had more evidence of emotional symptoms than those who were less severely hit. The spraying of herbicides contributed in both a general and specific way to the experiences identified as hard knocks. In regard to attitudes about herbicides, most of the people in the countryside held to the pragmatic belief that herbicides were a bad thing among many bad things that occur in war. In contrast, our study of pro-government and opposition newspapers from Saigon showed that the military herbicide program came to be viewed negatively by people in the cities. Herbicides came to be an emotionally charged symbol standing for many apprehensions and distresses, especially those for which Americans are blamed.

RECOMMENDATIONS

In what follows, the Committee recommends that action be taken in several fields as a consequence of its studies. Our first recommendation, however, is that the Committee's report be translated into Vietnamese. This is because it is the people of Vietnam who must live with the consequences of herbicide use and who must undertake remedial action.

It is also clear that Vietnamese effort to cope with the consequences of herbicide use will require financial and technical support from the United States. This should include the necessary funds, training for Vietnamese workers, the lending of technical and professional personnel as needed, and the supplying of equipment.

TCDD (Dioxin)

In view of the very high toxicity of TCDD (dioxin) to animals, and the presence of this substance in Agent Orange, which was widely used in the herbicide operations in SVN (approximately 10 million gal.), and preliminary reports of TCDD in fish in Vietnam on the one hand, and the lack of any data permitting assessment of TCDD effects on humans on the other, we strongly recommend two actions which should be undertaken simultaneously:

(1) Repeated systematic samplings and analyses of materials from Vietnam to verify the presence of TCDD and determine the level and distribution in human foodstuffs, animals involved in the human food chain, and river, estuarine and sea muds. Such samplings should be started immediately and should be repeated at intervals to follow changes that may occur with time.

(2) Long-term studies to obtain a firmer basis for assessing the potential harmful effects of TCDD on man.

Other Human Health Problems

Reports of Highlanders (Montagnards), in comparison with lowland Vietnamese, on death and illness caused by herbicides are so consistent that despite the lack of medical and toxicological evidence for such effects they cannot be dismissed out of hand and should be followed up as promptly as possible by intensive studies which should include medical and behavioral sciences approaches. Such studies will become possible only after peace has been restored in that area.

We strongly urge prompt evaluation of the data the Committee collected at the Barsky Unit of Cho Ray Hospital (see Section VII A-1)

and elsewhere to determine whether or not they indicate a relationship between exposure to herbicides and congenital malformations.

We also strongly urge a comprehensive medical study over time of the approximately 50 Vietnamese men who were heavily exposed as handlers of herbicides in the defoliation program, if they can be located, as compared with an appropriate "control" group.

Where defoliated areas are considered as resettlement sites (or have already been settled by new populations) epidemiological studies are recommended, directed at determining changes in populations of potential disease vectors and taking into consideration possible effects of different land-use types on the spread of disease.

Inland Forests

The inland forest regions contain major resources for the people of SVN. These areas have been subjected to the greatest amount of herbicide spray and to other war damage.

We therefore recommend that a complete inventory of representative samples of the forest be made as soon as possible, with particular attention being paid to reproduction and the young age classes of trees and to changes in forest composition, followed by studies to determine the consequences of war-related damage.

A systematic forest inventory is necessary for developing a basic land-use policy. When such a policy is established it may be appropriate to design specific procedures, for example with regard to conservation of forest reserves, for systematic reforestation programs. Forest utilization problems related to war-caused damage should be studied. In heavily damaged inland forest areas, plans and rehabilitation efforts should be initiated as soon as possible.

Mangrove Forests

The mangrove forests of SVN, which are economically important as a source of fuel and of food for fish, have suffered a greater damage than any other type of vegetation in SVN.

Since good inventories have been made of the mangrove forests, the first essential step appears to be the development of a land-use policy which, among other matters, would help determine how much of the mangrove area should be reforested and how much developed for agricultural and other uses. Both developments appear feasible although either one will undoubtedly require a considerable input of labor and capital. The Committee urges most serious consideration of the important role of mangroves as fish and shellfish breeding grounds which require the preservation or reestablishment of adequate forested areas.

Urgent attention should be given to proper utilization of mangrove forests, particularly in view of the increasing energy problems, and the possible need for more fuel in the future.

Records

Many records of the lower reporting levels (district, province) which would have been useful in answering in more detail the direct and indirect effects on agriculture or on movement or health of people were routinely destroyed after being summarized and forwarded to regional or national headquarters. We recommend the preservation of all remaining records relating to herbicide operations. These should be declassified where necessary and made available for further study. Records of this NAS Committee, including data bank, photographs, and other records, should likewise be preserved and kept available for later studies.

General Recommendations

Herbicides are an example of a modern technology which when employed on a massive scale for military use cannot be completely controlled, nor limited in time and space to their intended target. The Committee recommends that Congress, in appropriating funds for development and use of materials and equipment as weapons, also appropriate funds for independent study and monitoring in those cases where there is a serious possibility of any widespread or persistent ecological or physiological effects. The Committee's work is a convincing demonstration of how difficult it is to do this after the fact.

Herbicides were a grave concern to many Vietnamese and achieved symbolic and emotional significance which sometimes outweighed the actual facts. We recommend further studies in collaboration with the Vietnamese with a view to promoting greater understanding of the properties of these herbicides, of their peaceful uses, and their hazards.

Herbicides have been only one of the impacts of the recent war on the Vietnamese people. The various direct and indirect war impacts were however all closely interrelated, and it is the Committee's firm belief that rehabilitation and reconstruction efforts should not be fragmented according to different categories of damage but should proceed in an integrated fashion, and that such efforts be undertaken as rapidly as conditions permit.

We are aware of the complex and difficult nature of some of these recommendations, but we urge that the work here recommended be initiated promptly, since any delay will make its accomplishment more difficult.

Binary Nerve-Gas Weapons: Their Economic, Environmental, and Security Implications for the United States, Including Their Likely Effects on the International Chemical Disarmament Negotiations

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1. Introduction, Summary and Conclusions

In the summer and early autumn of last year, the U.S. Army disclosed that it was seriously considering large-scale procurement of a new generation of nerve-gas weapons. Plans existed for production to commence in 1977. The new weapons would differ from their predecessors in that they would not actually contain nerve-gas: they would instead be filled with two "relatively non-toxic" chemicals capable of generating nerve-gas when mixed. The chemicals would normally be separated from one another, and would be allowed to mix only when the weapons were in the process of being "delivered" to their targets.

It had been common knowledge for several years that research and development (R. & D.) on these so-called "binary munitions" was in progress. The significance of the Army's disclosure lies in its confirmation that binaries have begun to emerge from what the Department of Defense calls the "concept formulation" stage, and are already rather deep into the weapons acquisition process. Since the Army has apparently made up its mind on the need for binaries, it only requires endorsing decisions at Joint Chiefs of Staff and Secretary of Defense levels for the bureaucratic momentum gathering behind them to become irreversible. Indeed, since the fiscal year 1975 budget contains, for the first time, binary procurement funds, that point may already have passed. If Congress does not act to withhold these funds, literally millions of new nerve-gas weapons may soon began to enter United States arsenals around the world.

It cannot be said that, if this programme goes ahead, it will be because the Department of Defense (DoD) has failed to consider its liabilities. That might

have been possible in the 1950s and early 1960s, but today anything to do with CBW is too sensitive for decisions to be taken by default. Yet the risk most definitely exists that DoD may have undervalued certain of the associated costs to which decision-makers outside DoD would attach a much greater significance. But DoD has a monopoly of information on the binary programme, and therefore controls—intentionally or unintentionally—the inputs into the assessment which Congress, for example, ought to be making.

The present paper is an attempt at identifying the principal consequences that are likely to follow from a full-scale binary programme, and to distinguish the beneficial from the detrimental. The overall conclusion is that the costs, conceived in financial environmental and national-security terms, would greatly outweigh the benefits. Whatever the validity of this conclusion, the factors on which it is based need careful and dispassionate assessment before the binary programme should be allowed to advance to the point of no return. That point is clearly imminent, for the present time is one in which the interests vested in the programme are on the verge of a massive increase.

Binaries have been said by their promoters to be preferable to non-binaries for the following reasons: they would not necessitate specialised toxic-agent factories; by enabling more reliance on the US chemical industry, they would be easier to procure in an emergency, and would therefore permit cuts in stockpiling; they would be less hazardous, and therefore easier and cheaper to handle; and they would be more adaptable to technological advances. The emphases given to these features have varied over the years according to prevailing preoccupations. Some have since been discarded or become invalidated by events. The stress nowadays is on what might be called the "environmental" benefits: the safer and easier transportation, storage and "demilitarization" of binaries, and the prospects which they have opened up for disposal of the existing, highly unpopular, non-binary stockpiles. These benefits have now been subsumed within a lower-keyed claim, namely that binaries represent a sensible and routine measure of stockpile "modernisation."

The environmental and safety attractions of binaries undoubtedly exist, and they do, moreover, provide certain military advantages. But when a close examination is made of the binary programme as a whole, they fade into a background of heavy liabilities.

To see what the binary programme would involve if taken to completion, one may look first at the US Army's current predicament. The Army, through its Chemical Corps (or rather through those parts of the Army Materiel Command which, in 1962, absorbed the functions of the old Chemical Corps), is responsible for a stockpile of GB and VX nerve-gases which probably totals 40 or 45 million pounds, perhaps more. The greater part is filled into munitions which are now between five and twenty years old. According to the Army, the shelf-life of a filled nerve-gas munition rarely exceeds 15 years, beyond which it is likely that the munition will have become dangerously corroded, or that the delivery system for which it was designed will have become obsolete. Thus, by 1985 the entire stockpile of filled munitions will have outlived its useful life. The Chemical Corps is therefore facing three main alternatives. It can start buying a whole lot more munitions, basically the same as the old ones, but adaptable to modern delivery systems. This would represent an upgrading of the US chemical-warfare capability, but only at risk of provoking the same popular and Congressional outcry which made the Corps so unpopular with DoD during the late 1960s, and which almost led to its complete extinction. The second alternative is to give up the idea of maintaining peacetime stockpiles of nerve-gas weapons, and to concede the case for international chemical disarmament being argued within some sectors of the US Administration. This would be unattractive, it might be supposed, not only for institutional prestige reason, but also for what are essentially ideological reasons: to the extent that arms-control objectives have been accepted at all within DoD, arms control is seen as a complement to military strength, not as a substitute for it, as a guarantor of national security; to lend credence to the view that arms control is an alternative to military strength—that chemical disarmament could safely replace chemical deterrence in security policy—would be to create a precedent which DoD as a whole would find institutionally threatening. The third alternative is a compromise between the other two: to phase out the present stockpile in favour of one which does not present so many objectionable features, and which may therefore evade popular and Congressional odium.

The compromise, of course, is the binary programme; and the nature and extent of the programme are defined by the compromise. The 1969 Congressional strictures on Chemical Corps activities were stimulated by, and formulated in terms of, environmental and safety concerns. The Army will be unable to rest its case on the environmental benefits of binaries unless, ultimately, the complete nerve-gas stockpile is converted to binaries. The resultant binary capability must be capable of supporting present US CW policy; anything less than this would imply that the present policy is open to criticism. Therefore, a full range of binary weapons must be developed in time for procurement by 1985; anything less would imply that parts of the present range of non-binary nerve-gas weapons are superfluous.

What this will mean in practice is that the present, apparently modest, plans for procurement of binary howitzer projectiles will prove to be the tip of a substantial iceberg. The impression so far conveyed by DoD releases is that of a relatively small programme costing two or three hundred million dollars. In fact, it is possible to estimate from available DoD data that the dollar costs of a full binary programme would be well over a billion dollars, excluding demilitarization/detoxification of the existing stockpile. A decision to go ahead and buy the howitzer projectiles would not accord with current justifications for binaries unless it were also a commitment to design and buy everything else. And the net result is in fact unlikely to be an arsenal containing no non-binary nerve-gas: some may have to be retained in order to fill those munitions with which the binary concept is inherently incompatible.

Note also that, even though DoD is portraying the binary programme as a routine modernisation measure, it is not nerve-gas howitzer projectiles that are giving DoD its present stockpile-deterioration problems. The old and decaying nerve-gas weapons which are currently being destroyed are 98 rockets and cluster-bombs; but there has been no suggestion yet that binary replacements should be bought for them.

But however wasteful it may seem to spend $750m on the destruction of an arsenal of weapons and up to twice that amount again on the purchase of a replacement, the costs would be small compared with many other aspects of DoD expenditure. It is certainly true that the R & D component alone would support all CBW defence research (at present levels) in the UK, Canada, the Netherlands, West Germany and Sweden put together for a quarter of a century; but per year, over the eleven years intervening between now and 1985, it would represent less than 0.4% of DoD R & D expenditure. These are not, of course, reasons for condoning the programme; but they serve to illustrate the setting within which the various financial arguments for binaries should be located.

The environmental and safety benefits of the programme do not in fact stand close scrutiny. It is true that binaries would reduce the probability of sudden death on a large scale in the event of accidents with nerve-gas munitions, even though the binary components are themselves, in some cases, highly dangerous chemicals; but on DoD evidence, accidents with nerve-gas weapons have been extremely rare in the past. Moreover, the environmental costs of acquiring this benefit will be eleven years of open-air field-testing with nerve gas. It is true that DoD is saying at the moment that such testing may not be necessary, but the Army clearly—and with good season—thinks the opposite, and will almost certainly get its way if the programme goes ahead. But in any event, the environmental aspects should be viewed in an environmental prespective. Binaries are being presented as a solution to a particular set of environmental problems that arise from the existence of nerve-gas in the DoD supply network. Of all the environmental problems facing the United States today, does the nerve-gas one really have suffiicent priority to warrant the purchase of a two-billion-dollar solution?

The crux of the matter is that binaries are, after all, weapons; they should therefore be judged primarily as weapons, against a background of the particular security requirements that they are supposed to be fulfilling. Environmental and economic considerations are incidentals, however important they may be in themselves; at most they can be used to suggest bonus effects of greater or lesser value. But if they are used to evaluate what is essentially a security matter, the effect can only be meretricious. Yet justifications for binaries in terms of security considerations are conspicuous by their absence.

One criterion for assessing the security value of binaries is their capacity for supporting current US policy on chemical weapons. As regards nerve-gas, that policy has been stated in public many times: the United States will not be the first to use nerve-gas, but it maintains a nerve-gas capability in order to deter

enemy use of chemical weapons, and to provide a retaliatory option in the event of deterrence failing. Whatever the wisdom of that policy, the matter to be considered is whether binaries can fulfill it better than non-binaries.

With regard to deterrence, binaries appear to have the advantage of improving credibility. As matters stand at present, DoD is incapable of adjusting or effecting forward deployments of nerve-gas without provoking a major political outcry about transportation hazards. Because binaries may lessen the political constraint on stockpile management, they may restore flexibility to the overall deterrent posture. But the advantage here is significant only if it is exploited during peacetime, for in war the constraint would disappear; it is an argument in favour of binaries only if there are plans to pre-position stocks of them in forward areas before hostilities develop.

Yet the spectacle of the United States moving massive tonnages of nerve-gas weapons into Europe (and elsewhere), not merely during a period of peace, but also during a period of active diplomatic negotiations on the reduction of tensions and military forces in Europe, can scarcely fail to encourage misperceptions of intent. Potential enemies can be expected to perceive a threat and respond to it accordingly; and, on past experience, their response is likely to be seen in turn by DoD as an increased threat, even if it consists only of an improved CB protective stance. Thus, although binary nerve-gas may seem to offer a more credible like-with-like deterrent than non-binary nerve gas, it is very likely also to inflate the appearance of the threat which it is supposed to be deterring. In any event, the notion of nerve-gas deterring nerve-gas seems far too weak to be permitted to compromise the US negotiating position in the MBFR and CSCE talks.

With regard to the exercise of the retaliatory capability if deterrence fails, the central consideration is the relative combat efficacy of binary and non-binary nerve-gas. Here there can be no doubt at all that binaries will be very substantially inferior. They can be used in a considerably smaller number of combat situations; they will increase the relative effectiveness of enemy antigas protective postures; and, on a target-effects per unit of shipping-space basis, they will be less efficient by a factor in the range 1.2–5.

There is also a long-term security consideration to take into account. A significant diminution of the relative military strength in the world of the United States (and other nuclear powers) could result if nerve-gas, which is a relatively cheap weapon of great potency, were to proliferate around the world. To the extent that there is a role in international relations for US military strength—whether as symbol, threat, counterthreat or actuality—that role could then become weakened. With the employment of binary technology, the limiting factor in the acquisition of a national nerve-gas capability ceases, according to DoD, to be agent production, and instead becomes munitions fabrication, which is a much lesser obstacle. Binaries therefore increase the likelihood of nerve-gas proliferation, thus threatening, to some degree, the long-term security interests of the United States.

Finally, there are the security implications of the relationship between binaries and arms control to consider. The present position of the United States—and it is doubtful whether that position has yet received its full measure of policy review by the National Security Council—is that the risks to US security of enemy possession of nerve-gas are better countered by like-with-like deterrence than they are by international chemical disarmament, having regard to the possibilities currently available for verifying disarmament. Yet, despite the stringency of the demands which the US delegation at the CCD have been making with regard to non-production verification, it can be demonstrated that the security benefits of the like-with-like nerve-gas deterrent would be exceeded by those of a nerve-gas disarmament agreement which provided for (a) the guaranteed destruction of existing stockpiles, and (b) a measure of verification having anything more than a zero probability of constraining resumed production. The negotiation of such an agreement, though it will not be easy, is surely within the powers of the CCD. But the United States, rightly or wrongly, is not credited by its CCD colleagues with a constructive attitude towards the negotiations. If it were now to embark on a billion-dollar nerve-gas weapons acquisition programme, what confidence could remain in US good intentions? A decision to go ahead with binaries would almost certainly mean an end to the disarmament negotiations,[1]

[1] The fact that binaries are now known to be technically feasible has serious implications for the verification and scope of a chemical disarmament agreement, whether or not the US binary programme goes ahead. This topic is discussed most cogently in a recent paper by Johan Lundin (*1*).

NOTE.—Italic numbers in parentheses occurring throughout this paper refer to Literature Citations which may be found on pp. 322–326.

and with them a prospect for improving US security to a far greater extent than binaries ever could.

2. History and Current Status of the U.S. Binary Programme

2.1 Motivations in the binary program, and its history

In order to appreciate the problems which the binary program has put in the way of present disarmament endeavours, it is important to understand the motivations underlying the programme. Motivation in this sort of field can be analysed at several different levels. Strategic and military considerations present the outermost level: it is they that figure most prominently when decisions to do with armaments surface in public fora, becoming exposed to the prevailing political climate. They also provide the language in which the decision is formally debated within the bureaucracy. To a greater or lesser degree, however, this language is also a reflection of deeper factors: arguments expressed in terms of force-development, say, or of deterrence, may often, and more pertinently, be understood as statements of institutional, bureaucratic or other constituency interests. These in turn derive from still deeper factors, understandable, maybe, in terms of economics and sociology, or structure and psychology. But for an analysis of motivation to be useful in public debates surrounding armaments-technology decisions, it is best performed at the level at which the debate itself is conducted. The section which follows therefore describes and comments on the reasons for the binary programme in the form in which they have so far been presented to the public by the authorities concerned. The acount is roughly chronological, and is preceded by an historical introduction.

Although the existence of the binary R & D programme has been public knowledge for only about five years, it is in fact nearly twenty years old. Its early progress was slow, for it sought to provide a solution to a problem which at that time there was no great incentive to have solved, namely the hazards of storing nerve-gas munitions within the confined spaces of naval vessels.[2] The U.S. Navy has never been greatly attracted to chemical weapons, and by all accounts it has been glad of any justification to keep its involvement with them to as low a level as possible. During the 1950s, the Army Chemical Corps, which has long had a degree of inter-service responsibility for chemical-weapons development—and an interest in keeping its flag flying on as many fronts as possible—designed a range of nerve-gas ammunition for Navy equipments; it was the mixed reception given to this that directed attention towards the binaries. (The binary concept was already the subject of desultory study—as a means for providing field commanders with a range of chemical ammunition whose agent payload could be varied to provide a persistency suited to immediate field requirements.) In fact, attempts to stimulate what little Navy interest here was in the offensive possibilities of nerve gas did not meet with much success until after 1961. That was the year in which the Director of Defense Research & Engineering in effect ordered the R&D branch of the Navy (and the Air Force) to initiate or accelerate CB weapons programmes. Thereafter the shipboard hazards of nerve-gas ammunition became a problem to be contended with in earnest. Funds were suddenly fed into the Navy binary programme, which was still largely confined to the drawing board.

The binary concept was not the only approach to the storage-hazard problem,[3] nor was it a particularly original one. As long ago as 1909 it had been studied as a way of harnessing nitroglycerine (an exceptionally dangerous material to store in bulk) for use in explosive artillery shells; the binary components in this particular device—a thoroughly impractical one, it must be said—were nitric acid and glycerol, to be mixed under the influence of compressed air shortly before the shell was fired. (*5*) The idea surfaced again in 1942 in designs for a range of binary HE bombs and shells: the binary components were nitrogen peroxide and a liquid hydrocarbon, an explosive formulation of great power. (*6*) (*7*) By this time the concept was also being applied to chemical weapons, initially for the purpose of extending the time-period over which an aircraft bomb released its toxic cloud. The weapon concerned, a binary arsine device, was charged with

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[2] For a graphic illustration of how a pound or two of undetected toxic chemical can put an entire ship out of action, see Captain Saunders' account (*2*) of the 1943 mustard-gas episode in Bari harbour. A book-length reconstruction of the incident has recently been published (*3*).

[3] Another approach was to build an outer container of decontaminating agent into each nerve-gas munition. (*4*) This would serve to detoxify any nerve gas that leaked out of the inner container during storage.

magnesium arsenide and sulphuric acid, the two components being kept apart by a diaphragm designed to rupture upon impact. (*8*) Towards the end of World War II, the binary concept was also proposed as a means for exploiting toxic agents too unstable to survive prolonged storage; the agents in question were the N-nitroso-N-chloroethylcarbamates, vesicants thought to possess a greater insidiousness and eye-damaging capacity than the mustard gases. (*9*)

It is clear from its history that the binary concept is a versatile one, offering technological solutions to several different types of problem. This characteristic is still much in evidence in the present U.S. programme. In circles where technological prowess is highly valued, it seems to be a fact of life that the mere existence of a potential technological solution, even one to a problem of no obvious moment, has a tendency to upgrade the status of the problem to that of a bad situation requiring immediate remedy. And, of course, the more applications that can be claimed for a new technology, the more likely is it to be fostered. These considerations do not seem to have been absent from the minds of those people charged with the difficult task of selling binaries within the Pentagon and to Congress. Over the past four years they have accumulated within the public record a remarkable list of benefits that could accrue from binaries, and of the ills which they could cure. The emphases in the various presentations have varied according to the preoccupations of the day, so that the advantages being stressed this year are rather different from those of last year; but that is a familiar feature of all selling campaigns.

It may very well be, of course, that the true origins of the present binary programme are not to be found in any statement of requirement or identification of problem. It seems equally plausible that somebody in a laboratory one day had the idea of conducting the last stage in the process for making GB or VX—VX probably, since the V-agent binaries came first—inside an actual delivery munition. For both agents, the factory production process ends in an exothermic reaction performed at short residence-time in a simple T-mixer—reaction conditions, in other words, not incompatible with the closed internal environment of a munition. Thereafter it might be supposed that establishing the technical feasibility of the idea, and considering the different ways in which it might prove useful, were activities that proceeded side by side. Once the idea had been shown to work, arguments could be presented to higher R & D funding authorities in favour of prosecuting its further development; and later on, the force-development authorities in the Services themselves might be induced to establish formal requirements for particular binary weapons. The DoD bureaux having responsibility for such decisions all contained Chemical Corps people adept at upholding Chemical Corps interests.

The advancement of binaries out of the applied-research phase in 1961 was one small element in the five-year plan for expanded CBW R & D promulgated by DoD with Congressional support.[4] Much of the data needed for the chemical process side of the work was already available from GB and VX manufacturing experience.[5] On the dilevery hardware side, the Army let at least one R & D contract to industry,[6] but the greater part of the work was performed at the Naval Ordnance Test Station on China Lake, California. Both services were working on massive aircraft bombs that generated VX by the binary route, the Navy design being code-named *Bigeye*. (*13*) The Navy filed patent applications on theirs in October 1965 (*14*) (*15*), the Army doing likewise eleven months later. (*16*) The Navy's programme was expanded to include work on aircraft cluster bombs, and patent applications on these were filed in January and May 1968 (17). The binary components involved were both liquids, suggesting that the emphasis was on G-agent weapons. This was confirmed in the advertisement for tenders for and RDT&E contract on binary clusters that was published by the Navy in February 1969 (*18*).

The appearance of this advertisement, which was picked up by the press six months later via Congressman (as he then was) R. D. McCarthy's office, was virtually the first occasion on which people outside the Defense world got to learn of the binary programme. In June 1969 the first unclassified reference to the programme appeared in DoD Congressional testimony. This was in reply to a question expressing concern about the hazards to human life of having nerve

[4] During the five-year period FY 1960–64, annual expenditure on CBW RDT&E rose from $49m to $129m ,current prices). For a documented account of this, and of the five year plan. see Volume II of the SIPRI study. (*10*).

[5] Thus, it was the corporation manufacturing VX for the Army at Newport Chemical Plant that produced one of the earlier reference works on binaries. FMC Corporation's *Binary Data Study* (Vol. 1: "Binary reaction results"; Vol. 2: "VX spray results"). (*11*)

[6] Contract no. DA–18–108–405–cml–1098 with Aircraft Armaments Inc., a company closely involved in Army chemical-weapons work. The contract was let, apparently, in June 1961. (*12*).

gas in storage so close to Denver Airport, at Rocky Mountain Arsenal. The witness, Colonel Osick[7] from the Army Department, in fact evaded the question, and spoke of manufacture rather than storage; he said "We think in the next five years certainly we can see our going to a binary-type of munition. . . . If this does come to pass, we feel that for Rocky Mountain Arsenal, as a producer of nerve agent as we have known it, the requirement does not exist." (*19*)

This, then, was the first strand in the case for binaries which the Chemical Corps now began to present to Congress. What Colonel Osick had in mind, as DoD subsequently explained for the record, (*20*) was that since binary components were "relatively non-toxic", heavy investment in safety measures would not be a prerequisite for their manufacture, thus permitting their procurement from industry by competitive contract purchase: there would no longer be any need for DoD to maintain its expensive, and highly specialised, nerve-gas factories. Moreover, since the US chemical industry was so capacious, capable—so it was claimed—of turning out large tonnages of binary components at short notice, it would no longer be necessary to maintain large stockpiles of chemical agents.

Nearly five years have since elapsed. The nerve gas is still there at Rocky Mountain Arsenal, and on the present demilitarization schedule it will not be gone until the end of 1976. The chemical industry has not lived up to expectations, for the Army is now seeking funds to build its own factory for one of the binary components. The Army will presumably be stockpiling this component with customary plenitude.

So far, the advantages claimed for binaries were twofold: they would do away with the need for expensive nerve-gas factories, and they would cut back on stockpiling necessities. Further advantages were set out in DoD's clarification of the Osick statement:

Binary munitions are very much more safe than previous chemical munitions. They can be designed so that one of the two chemical components is inserted, along with fuze and burster, just before firing. During storage and transportation, the two components could be completely separated so that even if serious accidents occurred there would be no possibility of formation, much less release, of toxic material. (*20*)

The prospects for removing storage hazards were, of course, what had been impelling the Navy's binary programme, but the transportation question, although closely related, was a separate, and ultimately much more important, matter The early Summer of 1969 was the time when DoD in general, and the Chemical Corps in particular, were being exposed to strong domestic criticism over plans for transporting 27,000 tons of obsolete or decaying chemical agents and weapons across the United States prior to "ocean burial". The critics argued that the hazards of transporting this material through populated areas, particularly the 21,000 old nerve-gas cluster-bombs involved, were too great to be countenanced. Their voices ultimately prevailed, adding to the growing discomfiture which the Chemical Corps had been experiencing from public opinion. Although the Corps was being attacked for many different reasons, it seems that this particular episode made an especially deep impression, so much so that over the subsequent years the Corps came to believe that if it could allay the public's fears about transportation hazards, it would be restored to general grace and favour. Accordingly, the binaries were suddenly given greatly increased priorities in the Corps' R & D programme. During the fiscal year ending in June 1969, they accounted for no more than a per cent or two of the Corps' expenditure on chemical-weapons R & D; in the following year the figure was about 25%, rising to above 50% in FY 1971. In FY 1973 it was nearing 70%, and it now accounts for virtually all of the lethal chemical weapons R & D programme.[8] It is clear from DoD

[7] Colonel Osick was then Chief of the Systems and Requirements Division in the Directorate of CBR and Nuclear Operations, which is part of the Office of the Assistant Chief of Staff for Force Development.

[8] And in the incapacitating chemical weapons programme also work is being done on the application of the binary concept to incapacitating agents. (*21*) The percentage figures here are my own estimates, but they are derived from DoD data. Figures for Army R&D expenditure on binaries up to and including FY 1970 are contained in DoD Congressional testimony (*22*). For the fiscal years 1971, 1972 and 1973, figures for Army CBW R&D expenditure, itemised into the major programme elements, but not specifically identifying the binary projects, have been released by DoD. (*23*) Estimates for binary expenditure during these years may be made by comparing the figures for the programme elements known to include binary projects with the OSD obligation report on the CBW programme for the second half of FY 1973 (*21*). (That the result may in fact be an underestimate is indicated by a recent press report quoting a figure of more than $50m for the binary R&D programme to date, (*24*) rather than the ca. $30m figure I arrived at.) Figures, of varying degrees of reliability, for total chemical-weapons R&D expenditure for 1969–73 are available in several places: for details, see Vol. II of the SIPRI study. (*10*)

Congressional testimony given in 1970 that before the Summer of 1969 the Corps had been only marginally interested in binaries:

Prior to fiscal year 1970, funds obligated for binary lethal chemical agent and weapons system development in the Army were for long-range planning and for monitoring other service development efforts. The Navy in particular[9] was interested in binary system development to increase shipboard safety during storage and handling operations. (*22*)

Chemical Corps Congressional testimony on the FY 1971 budget emphasised the transportation benefits of binaries, but made no reference at all—for good reason, as has now transpired—to the manufacturing and stockpiling aspects. A new argument for binaries was, however, also put forward:

Another value of the system . . . is the fact that if, as we go down the road a few years from the time we field this round [a binary artillery projectile], we find a better agent combination, all that needs to be done is to remove one of the polyethylene canisters and replace it with a different combination, and you have a new agent without having to build new hardware. (*25*)

This flexibility argument seems to have been a reflection of a new element that was affecting Chemical Corps planning. It had been felt for some time that the service branches would show more enthusiasm for Chemical Corps activities if a reduction could be made in the number of different chemical weapons that combat troops were expected to know how to use in the event of chemical warfare. One way of doing this would be to develop a new nerve gas that could replace both GB and VX—i.e. one that could combine the vapour effects of GB with the persistent and percutaneous effects of VX.

Thus it was that the Chemical Corps' "Intermediate Volatility Agent" (IVA) programme came into being. The most promising line of enquiry was presented by those G-agents, such as soman (GD), which are less volatile than GB, but no such agent could be found that possessed the other properties demanded of a CW agent. If a suitable IVA were to be found at some period in the future, it might indeed be possible to generate it in the binary mode merely by exchanging the alcohol container in current GB binaries for another alcohol container. Moreover, it might become feasible to make several different alcohol containers available to field commanders, enabling them to select an agent whose volatility—and therefore persistency—was best suited to immediate tactical requirements (an idea dating from 1954, as noted earlier). The force of this line of argument is blunted, however, by a consideration which the Chemical Corps did not remark in its testimony. There are significant differences both in the densities of the alcohols that might be used, and in their rates of reaction with the second binary component, and in the stability of the resultant IVA in the presence of other binary reaction products. All of these factors are likely to have a major effect on the ballistics, utility and effectiveness of the binary munition. Thus, although binary GB hardware might indeed be used with different IVA fills, the efficiency of the munition would undoubtedly decline. The Chemical Corps, is, of course, well aware of this fact (despite the testimony quoted above), and its current binary R & D programme includes a special project on IVA hardware.

Testimony on the FY 1972 budget introduced yet another strand into the case for binaries, although again it was transportation safety that continued to be emphasized. The new argument, once more, was related to an immediate preoccupation of the Chemical Corps, namely the demilitarization of obsolete chemical weapons (*29*). The stocks of old nerve-gas bombs—M34 GB clusters—whose "ocean burial" had been blocked in 1969 were still lying around, and the Corps was publicly committed to removing them from their resting-place near Denver airport, or destroying them in situ. Neither of these could it do, however, without satisfying the recently introduced safety legislation, and this was proving a difficult and time-consuming process. In the meanwhile, voices of criticism and derision could be heard, decrying the fact that the Corps had built weapons which it seemed incapable of dismantling. Binary munitions with their removable containers of "relatively non-toxic" chemicals, thus seemed still more attractive to the Chemical Corps.

In April 1972 an article was published by the then Commandant of the Chemical Corps school at Fort McClellan (an exceptionally able and far-sighted

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[9] Very little is known about Air Force interest in binaries. In Congressional testimony during 1970, an Air Force witness stated that "we are currently reviewing this [binary] munition to see whether . . . it is truly required and useful" (*26*). A press report in December 1973, stated that the Air Force had established a binary requirement. (*27*). A bewildering reference exists to an Air Force Armament Laboratory report of January 1967 entitled "Binary biological weapons. Part II. Safe handling concept". (*28*)

chemical officer, by most accounts, and the author of a book on CBW which has yet to be cleared by DoD for publication). Entitled *The Chemical Corps: Alive, Well and Visible*[10] it included the first publicly-released picture of the XM687 155 mm binary GB howitzer projectile. It stressed the transportation and storage benefits of binaries, but did not comment on any of their other attributes. (*30*)

The fiscal year 1973 Congressional testimony on the binary programme, particularly before the House Armed Services Committee, (*31*) was rather more extensive than before, bringing together all of the arguments in favour of binaries that had been put forward in previous years. It included confirmation that the Navy had by now abandoned its binary programme, (*32*) which was something that had been hinted at in the previous year. (*33*) (*34*) It also raised the thorny question of renewing open-air testing of nerve-gas weapons. In 1969, in the wake of the Dugway sheep-kill, Congress has passed legislation[11] forbidding this except in specific cases that had been certified as necessary for national security by the Secretary of Defense; environmental-impact precautionary procedures were also specified in the legislation, together with the requirement that Congress be given 30 days notice prior to commencement of testing. Now, in February 1972, the Army was telling Congress than "open-air testing with lethal agents will be requested to confirm weapon efficacy of the binary 155 mm projectile prior to procurement." (*35*) Little more was heard of this until 15 November 1973, when the Secretary of the Army, Howard Callaway, was reported as having said that the Army planned to test binaries in the open air unless higher authorities objected. (*36*) This provoked an immediate press-release from the Assistant Secretary of Defense (Public Affairs):

. . . there is no approved plan or program within the Department of Defense or within the Department of the Army at this time for any open air testing of nerve agents. . . . We do have a previously announced programme aimed at developing for our chemical deterrent stocks a safer binary munition. At this time we hope that any tests involving this safer munition can be accomplished using simulant agents and not active nerve agents or in a closed laboratory environment rather than in the open air. Of course, we would comply with all safety requirements and laws were any tests thought necessary, but right now we doubt that they will be necessary and have no plans at all for any such tests. (*34*)

Secretary Callaway was then quoted as having said he had been misunderstood by newsmen; but he also remarked that "open air testing is better from a military standpoint . . . a laboratory test just wouldn't tell us as much." (*38*) A difference of opinion on the matter therefore seems to exist within the Pentagon.

Shortly before all this, on 18 September 1973, the Office of the Secretary of the Army had informed Congress that the binary programme had advanced to the point where Pine Bluff Arsenal, Arkansas, had been selected as the site for production of one of the chemicals for a particular binary projectile (in fact the XM687 projectile referred to above). The plans for Pine Bluff included munitions-filling facilities as well. The news release (*39*) also advanced yet another argument for binaries, but this time it was an argument that appears to be much more closely related than previous ones to the realities of the political process which will ultimately determine the fate of the binary programme. The relevant passage reads as follows:

The binaries will represent a significant improvement in modernizing our chemical retaliatory capability, and will permit the disposal of present stocks of nerve agents as they are replaced by the binaries.

In stating that binaries "will permit" disposal of existing nerve-gas stocks, the implication was clear that unless procurement of binaries was approved, those stocks—unpopular, dangerous and decaying as they are—would have to remain, hanging as an albatross around the necks of Congress and DoD alike.

The Chemical Corps thus seems to have found a measure of support for its binaries within the highest reaches of the Army. Moreover, in a further release

[10] And therefore suggesting precisely the opposite. In January 1973, a further reorganisation within the Army—the imminence of which no doubt influenced the article—virtually destroyed what little autonomy remained to the Corps after the 1962 reorganisation. The Corps cannot be entirely dismantled—as many people in DoD clearly wish—without repealing the national legislation that established it in 1948. The legislation does not, however, specify a size for the Chemical Corps so that DoD can—as it is now doing—subject the Corps to *de facto* elimination: it can disestablish existing Chemical Corps slots in the DoD bureaucracy, reassigning personnel to Ordnance, or other, duties.

[11] Included in PL 91–121, and expanded and amended in PL 91–441.

to Congress on October 3d by the Office of the Secretary of the Army it was stated that following "a review of the Joint Chiefs of Staff of the entire national deterrent stockpile of chemical agents and munitions . . . the JCS have determined that the disposal of that portion [12] stored at Rocky Mountain Arsenal would not be imprudent in view of improved technology becoming available in this field." (*40*) Thus, not only does the Army seem to be foreclosing on the option of doing away altogether with peacetime stocks of nerve gas via an international chemical disarmament agreement, but the JCS also seems to be moving, publicly, in that direction.[13]

As matters stand at present, DoD is presenting the binary programme to Congress as a routine act of stockpile modernization, one which takes advantage of the benefits claimed in earlier years. To the casual onlooker, this may seem an objective reasonable enough to justify the binary programme. The Army has certainly been having problems with some of its nerve gas weapons sufficiently great to warrant the purchase of replacements—assuming, that is, that the weapons are still needed. Because of aging and corrosion, the Army has been forced to dispose of all of its stocks of GB cluster-bombs, and most of its stocks of GB rockets. These munitions account for a major part of the immediately-usable retaliatory capability. Yet these are not the munitions which the Army is at present seeking to replace with binaries. Instead, the Army is planning to commence its "moderization" programme by procuring binary replacements for what are probably the most stable and age-resistant of all its nerve-gas munitions, namely GB and VX howitzer projectiles.

2.2 Present state-of-the-art of binary technology.[14]

It would be a mistake to suppose that anything like a complete nerve-gas capability, exploiting the binary concept, is now accessible to procurement. That situation is still a long way off, in fact well over a decade away, probably two decades, at the present rate of progress. What it is that is now nearly available is a limited and unproven binary capability for two particular artillery weapons—the 155 mm and 8 inch howitzer systems. These weapons, it is true, have always been considered to offer one of the better ways of spreading nerve gas in combat situations; but, on the evidence of existing nerve-gas stockpiles, DoD authorities seem to believe that a nerve-gas capability cannot adequately fulfill its stated mission for the United States unless it comprises a much wider range of weapons. (For information on the present arsenal, see Appendixes 1 and 2.) Medium and heavy artillery projectiles are far the easiest types of munition to which to apply the binary concept. The development of further types of binary munition will therefore be a good deal more time-consuming and expensive, and may in some cases prove impossible. Yet a decision to embark upon procurement of 155 mm and 8 inch binary projectiles would be incompatible with the logic which DoD has advanced in support of binaries unless it was also a commitment to acquire, ultimately, the complete range.

The most difficult requirment made of the chemists working in the binary programme is that they should provide pairs of low-toxicity chemical reactants that are, on the one hand, capable of spontaneously reacting together in a space of seconds to produce a high yield of nerve gas, and, on the other hand, sufficiently stable to survive prolonged periods of storage. But highly reactive chemicals tend to be unstable on storage; they also tend to react with biochemical substances in the human body, thus exerting toxic effects. Yet another difficulty is that the chemicals should ideally be liquid at ambient temperatures: the involvement of solid chemicals complicates the mechanics of binaries.

The more obvious chemical possibilities open to binaries are described in Appendix 3. For various reasons, attention has focused on binary formulations capable of generating the standard agents GB and VX, although, as noted earlier, work is also being done on the development of a binary "intermediate volatility agent" (IVA). The progress that has been made in developing candidate binary combinations can be summarized—insofar as it can be deduced from the open literature—as follows:

Binary GB (GB2) present no great problems. The two components favoured at present are methylphosphonic difluoride ('difluor'), code-named DF, and

[12] For details of this, see Appendix 1.

[13] It was reported in the press on 28 November that the JCS had not in fact yet reached a decision on binaries. (*41*)

[14] Except where stated, the principal source of information for this section was the Secretary of Defense's CBW obligation reports to Congress for the second half of FY 1973 (*21*) and the first half of FY 1974 (*79*).

isopropyl alcohol, code-named IP. A reaction-accelerator code-named KZ, probably an amine, is included in the IP. Both components are liquids, and both are stable on storage (provided the storage-containers are dry and air-tight). One potential difficulty, however, is that DF is poisonous and very unpleasant to handle: only Chemical Corps people, used to the extreme hazards of nerve gas, could describe it as "harmless" or "relatively non-toxic".

Binary VX is a more difficult proposition. The most extensively studied combination is a liquid/solid one, and it is only very recently that a candidate liquid/liquid combination has appeared. Ethyl 2-diisopropyl-aminoethyl methylphosphonite, code-named QL, is used in both of them. The solid reactant is sulphur (although in what particular form has not yet been disclosed). The second reactant in the liquid/liquid combination is something code-named NM, and is presumably an alkyl disulphide, episulphide or polysulphide. Neither QL nor NM is particularly stable during storage. QL reacts violently with air or water.

Binary IVA is lagging. The problem is not so much how to generate an IVA binarily, but to know what to generate. Soman (GD) and GD/GB mixtures were studied, and apparently rejected, some time ago. (*42*) (*43*) Attention is being given at present to two candidate IVAs, known in public only by their code-names: EA 1356 and EA 5365. To judge from these symbols, EA 1356 is a G-agent, one that was first studied by the Chemical Corps in the late 1940s or early 1950s; EA 5365 must have come up only within the last three or four years. Since virtually all conceivable G-agents were first synthesized many years ago (largely through the diligence of A. H. Ford-Moore at Porton in the UK), and since the V-agents are probably too inviolatile to be used as IVAs, EA 5365 may be an entirely novel type of nerve gas. This is a disturbing possibility for those concerned with the design of chemical-disarmament verification schemes. It is also conceivable, however, that EA 5365 might be a mixture of an old agent with some sort of additive capable of modifying agent volatility.

A further requirement made of binary chemists—and in some ways more difficult still—is that they should also provide binary simulants. These must be low-toxicity materials that (a) resemble the binary components they are simulating in their physical properties; (b) interact in a reaction that closely resembles that of the simulated binary reaction both in kinetics and in thermodynamics; and (c) interact to form a low-toxicity product whose vapour, aerosol or spray characteristics resemble those of the simulated binary product. These are virtually impossible objectives, yet it is only if they are met that open-air testing of binaries can, with confidence, be dispensed with.

As for binary hardware, the main design problem is the difficulty of providing for adequate mixing of the component chemicals without at the same time creating a munition that is too bulky to meet operational requirements, or too complicated to be both reliable and robust. Artillery projectiles are relatively easy since the massive set-back forces to which they are exposed on firing (accelerations of around 5,000g) can be exploited to rupture diaphragms separating the binary components; and the spin imparted to the projectile by the rifling of the artillery-piece can be exploited to mix the chemicals. For munitions such as aircraft bombs, however, some sort of motor or internal propellant must be provided.

Listed below are the different experimental binary munitions known to be under development, with details—where possible—of their present status.

Binary GB Projectile, 155 mm Howitzer, XM68F

In design, this is the simplest of all the binary munitions under study, and its development is the furtherest advanced. Its chemical payload, weighing about 6kg (*44*) or perhaps more, is contained in two plastic cans loaded one behind the other into the projectile casing, the interfaced ends being rupturable under the influence of set-back forces. The binary product is disseminated by a burster-charge in the nose of the projectile. Advanced-development prototypes became available for field-testing in 1969, and 32 of them were let off at Dugway Proving Ground (*22*), all but one with GB2-simulant payloads. Tests with others, apparently about thirty, all with active GB2 payloads, were scheduled for the year (*44*), but the schedule was abandoned in the face of legislation passed by Congress forbidding open-air test releases of lethal chemicals (*45*). The projectile entered engineering development in fiscal year 1971, and environmental-impact statements have been drafted in anticipation of DT II open-air testing during FY 1974. The drafts have not yet been approved within DoD, however, and, as noted

earlier, there seems to be some controversy within DoD about the necessity for the tests. It is said that present plans envisage the production of 700 engineering-design rounds at Pine Bluff Arsenal; these are presumably what is considered necessary for the DT II programme.

Apart from proving design, the principal work remaining to be done on the projectile is the verification of the dispersion and dissemination characteristics predicted from simulant and chamber trials. Such work, which would normally be part of the engineering-test programme, would provide the basic data needed for the computation of artillery munitions-expenditure tables. Existing tables calculated for the non-binary 155 mm rounds would provide some guidance, but the binary and non-binary rounds differ in two important respects: the non-binary round has a smaller payload, and it uses a central burster. A centrally burst munition yields an agent cloud having a different shape, in terms of dosage-distribution, from that yielded by a nose-burst munition. It is, however, conceivable that the resultant differences in actual effects would fall well within the range of unpredictablities that in any case affect the non-binary round. No amount of open-air testing could improve such a situation.

Apart from this, though, there are two other reasons why field-testing would probably be regarded as indispensable. The first is that the ballistics of an artillery projectile are heavily dependent upon internal symmetry; it would therefore need to be established that the rupturing of the diaphragm separating the two binary components did not introduce sufficient asymmetry to influence the range and accuracy of the projectile. Simulant field-trials might perhaps provide adequate data for this, but they could not cope with the second problem. This arises from the fact that a binary munition does not disseminate pure agent; rather, it dissiminates a reaction-mixture, the nature of which could be deeply affected by climatic conditions. For example, the GB binary mixture yields hydrofluoric acid as a by-product: this is a hygroscopic substance, one which will therefore have a tendency to draw atmospheric moisture into the reaction product. GB is destroyed rather rapidly by water under the acid conditions that would prevail, at a rate that is temperature-dependent. It follows, therefore, that the effectiveness of a GB binary is likely to be influenced by local conditions of atmospheric humidity and temperature. The extent to which this and other atmospheric perturbations of performance may arise can only be determined by open-air "hot-agent" field-testing under a range of different weather and climatic conditions.

In the FY 1975 budget, the Army is seeking $5.8m in initial procurement funds for the XM687 round. This project-element ("5750317—Pine Bluff Arsenal: IPF—Chemical Production and LAP facilities for 155 mm binary projectile XM687") is one of many others listed in the justification book under the project heading "Provision of Industrial Facilities", which in turn is one of the projects forming part of P–1 line item 81–83. Procurement of Ammunition, Army: Protection Base Support. The funds are evidently being sought for two purposes. First, to build a manufacturing installation for DF (the production process presumably being flourine substitution into commercially-procured dichlor); and, second, to load, assemble and pack complete 155 mm rounds. It is to be noted that, if the DF factory is indeed built, it will presumably have a sufficiently large capacity to support a full procurement program for all binary GB munitions, not merely the XM687.

Binary VX Projectile, 8-Inch Howitzer, XM736

This munition was still in concept-formulation stage in 1972, but was scheduled to enter engineering development in the Autumn of 1973 (put forward, subsequently, to early 1974). There are two basic designs, both of which have been competitively prototyped. The "bulk-expulsive" design is presumably rather like the 155 mm GB2 round but with a relatively smaller explosive charge for achieving a base-ejected spray. "The submunition" design ejects a plurality of explosive-burst canister, each containing a binary loading, during its trajectory. With simulant payloads, both designs have been field-tested at Dugway. Both liquid/liquid and liquid/solid binary-VX fills have been studied, but since NM has only recently appeared on the binary scene, the liquid/liquid design is presumably less developed. Nevertheless, it is a liquid/liquid design (bulk expulsive rather than submunition) that is being advanced to engineering development. Process studies on NM are scheduled for advanced development in FY 1974: prosecution of the development of all binary VX munitions may be delayed, it might be supposed, pending the outcome of this.

Binary IVA Projectile, 155 mm Howitzer

This munition was still in exploratory development in FY 1973. It was scheduled to enter advanced development at the end of that year, but this was delayed by the absence of a suitable IVA. Advanced development is now scheduled to begin in the summer of 1974. Two types of hardware design are being studied side by side. One uses explosive dissemination, and is presumably intended to maximise respiratory challenge by IVA aerosol. The other uses expulsive dissemination, presumably in order to maximise percutaneous challenge by discharging an IVA spray. It may well be that if the IVA programme eventually reaches a successful conclusion, two families of munitions exploiting each of these disseminating techniques will be necessary, if IVA is to substitute for both GB and VX. The logic of replacing two types of agent plus one family of munitions with one type of agent plus two families of munition is presumably that munitions are easier to procure than agents.

Binary Missile and Ground-Rocket Warheads

Army work on binary missile warheads, presumably for Lance, was still in exploratory development during FY 1973, but included the fabrication of experimental hardware. Cost-effectiveness analyses were being performed to determine the relative advantages of charging the warhead with GB, VX or IVA. Similar, and related, decisions were being made about the relative merits of massive, segmented, or bomblet configurations for the warhead. The work is thus still in an early concept-formulation stage. No open reference exists to work on binary equivalents for such munitions as the 155 mm Bolt rocket for multibarrelled rocket-launchers.

Binary VX Aircraft Massive-Bomb

As noted earlier, the development of this munition preceded the work on the artillery projectiles described above, the pace being set by the Navy with its Bigeye bomb of the mid-1960s. Bigeye had got as far as engineering development by FY 1970. (*44*) If the Navy's patents on a liquid/solid bomb design (*14*) (*15*) do indeed relate to Bigeye, it is clear that Bigeye was a peculiarly complicated device. The patent specifications describe the use of a pyrotechnic propellant inside the bomb to inflate a balloon for forcing the solid reactant into the liquid one after rupturing a container, the broken edges of the container then constituting paddle-blades, for mixing the reactants, driven by an electric motor. This process would be initiated while the bomb is still hooked up to the aircraft. During descent of the bomb after release, the binary product would stream out through slits explosively formed in the bomb casing (rather along the lines of the old British "Flying Cow" mustard-gas bombs of World War II. (*47*) The Army's design for the bomb is one of similar complexity; (*16*) it differs primarily in the use, not of an electric motor (requiring an external source of power), but of either a rocket-propelled motor or a compressed-helium motor to mix the reactants. No reference work on these, or any other massive-bomb designs since the late 1960s has appeared in the open literature.

Binary GB Aircraft Cluster-Bomb

The only published information on this munition relates to Navy work during the later 1960s, now abandoned. In the published design, (*17*) one of the binary reactants is charged into explosive-type bomblets, the interiors of which are closed off by one-way entry valves; the bomblets are clustered inside a clamshell container that can be topped up with the second binary liquid, so that when a source of pressure is activated inside the clamshell, the second liquid is forced into the bomblets, where it reacts to produce nerve gas. The interest apparently was in a cluster that could be externally-carried on supersonic aircraft, for use against surface targets. (*18*)

Binary Air-to-Ground Rockets

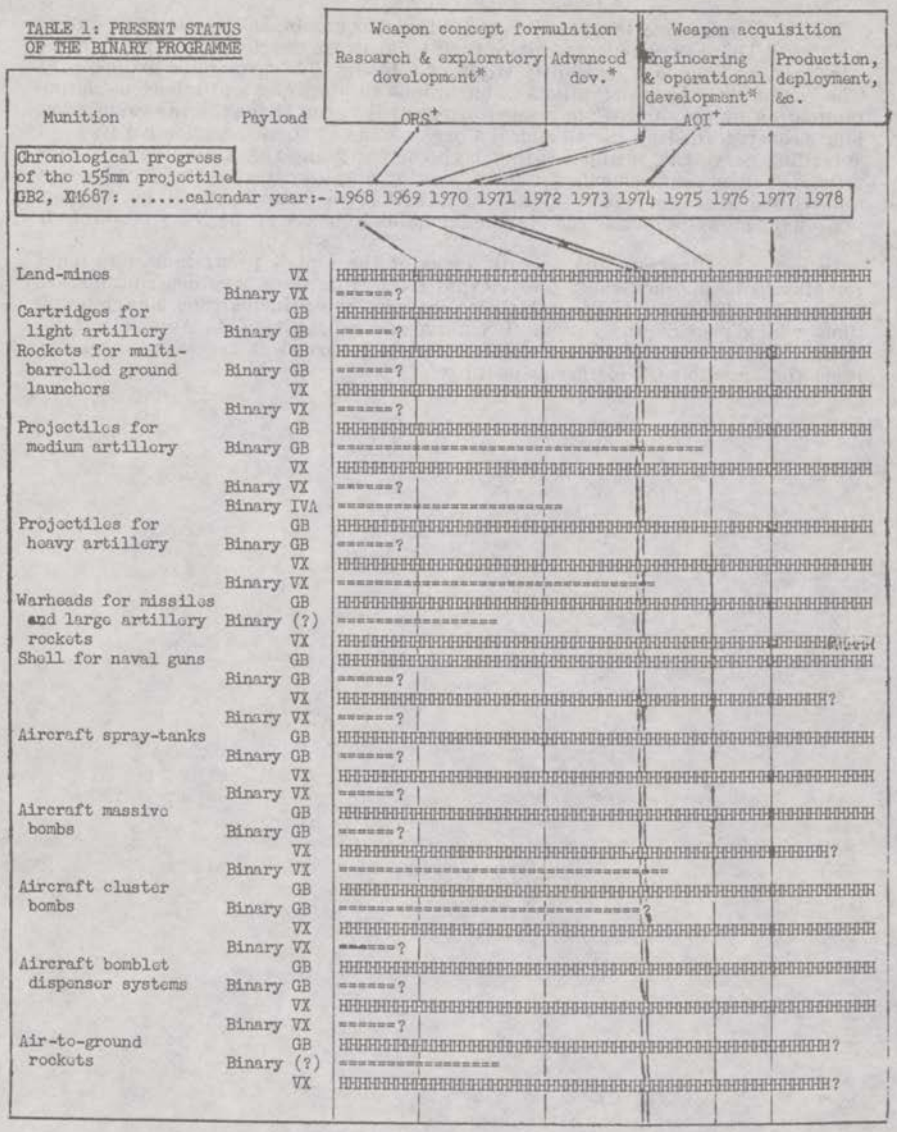
Army work in this area still seems to be in early concept-formulation stage. No information has been released on the agent or agents under study. Experimental hardware was being fabricated during FY 1973.

Binary Aircraft Spray-Tanks

The only reference to a binary spray-tank occurs in DoD testimony during 1969. (*48*) There is no open reference to any hardware development, although the Air Force completed a feasibility study of a binary VX spray-tank in 1968. (*81*) The conduct of spray operations is hazardous to aircrews, and laborious decontamination of the aircraft is needed afterwards; even though spray-tanks have long been regarded by the Chemical Corps as one of the most effective ways of spreading nerve gas, it appears that both the Navy and the Air Force have now rescinded their requirements for them, leaving only the Marine Corps competent and willing to conduct spray operations. Whether the army is, or will be, developing binary spray-tanks for the Marines remains to be seen; the Navy certainly is not.

In order to illustrate the overall status of the binary programme and what remains to be accomplished, the relevant data from the above descriptions are summarised in Table 1. The table also includes the principal non-binary munitions which provide the current US nerve-gas capability (see Appendix 2 for further details); all of these are, presumably, regarded as necessary inventory items for a credible CW-deterring posture.

TABLE 1: PRESENT STATUS OF THE BINARY PROGRAMME



Notes for Table 1

A question mark at the end of a progress line means that progress to the point indicated can reasonably be assumed, but without confirmation from the open literature. It is probable that a number of operational non-binary munitions are still on the secret list, and the same may apply to certain binary developments.

+ORS means 'operational requirement specified'. AOI means 'approved for the operational inventory'.

*The separation of phases in the development process indicated by the different columns follows that of standard DoD R & D management.(49)

Research and Exploratory Development constitute the routine work of laboratories having the general mission of developing a particular technology. Edgewood Arsenal is the principal DoD centre for CW technology, and among its staff it has various groups working in the binary field. These people will be doing laboratory studies of existing concepts for binary weapons and thinking up new ones. When a new concept takes shape - an idea, say, for a new type of binary rocket - it is examined for military utility and technical feasbility, the latter being one of the main functions of 'exploratory development' and commonly involving the construction of 'breadboard' bench-models. If an operational requirement then develops, or has already been formulated, and if technical feasibility is established, the concept enters Advanced Development. This involves the fabrication of components for a prototype weapon, or for competing prototypes, embodying the concept. Field trials of the prototype may then be conducted. If these are successful, the concept is poised to enter Engineering Development, and a detailed review process begins in which a range of wider considerations are brought in - probable costs, available alternatives, Service appraisals, &c. - in order for the Office of the Secretary of Defense to decide whether further development is likely to be worthwhile. A decision to embark upon engineering development is the first step in the weapon acquisition process, and implies a substantial probability (but by no means a certainty, as in the case of Bigeye) that full development will follow. Engineering development, which includes extensive field-testing, culminates in a review to determine whether the weapon should be approved for the operational inventory. If it is approved, Operational Development begins, in which the manufacturer establishes his production design and his processes for quantity production, and in which the user Service tests and evaluates the weapon against performance requirements. In some cases a decision approving the weapon for the operational inventory is taken at the same time as the decision approving engineering development, in which event engineering and operational development proceed side by side.

3. Costs and Benefits of the Binary Programme

Insofar as it is possible to gauge present intentions concerning the binary programme, it looks as though DoD definitely anticipates buying a binary capability for medium and heavy Army howitzers, with procurement of 1–2 million binary projectiles to commence in about three years time. According to the logic so far articulated by DoD for the US nerve-gas capability in general, and for binaries in particular, approval of these plans would also mean that

(a) The general objectives of the binary R & D programme would be upgraded to the specific objective of providing weapons for procurement in place of the greater part, if not all, of the present nerve-gas stockpile;

(b) In order to meet this objective before the present stockpile of filled nerve-gas munitions outlives its safe shelf-life, the binary R & D programme would be expanded and accelerated; and that

(c) Authorization would almost certainly be sought to conduct a continuous succession of open-air nerve-gas tests with each new binary munition.

Approval of the plans on the basis of their present justification would presuppose that the Army intends to destroy the present stockpile of filled nerve-gas munitions as and when binary replacements become available. It is likely, however, that the Army would seek to retain at least part of its present stockpile of bulk nerve-gas in order to provide a capability for filling those munitions, such as land-mines, to which the binary concept could not be applied.[15]

All in all, therefore, a decision to go ahead with the XM687 and the XM736 would be a loaded one, likely to involve a good deal more than appears at first sight. But possibly the ramifications noted above do not in fact form part of DoD plans. Yet if that were the case, it would mean that the present DoD justification for maintaining a peacetime nerve-gas capability requires critical re-examination, or that binaries are a luxury which can be dispensed with.

Whatever its ultimate implications, however, the Army has presented a case for acquiring a new generation of nerve-gas weapons, and it is a case which the authorities concerned are going to have to judge on its merits. The factors which must enter into their assessment fall into three broad groups: economic factors, environmental and safety factors, and national-security considerations. They are discussed in turn in the pages which follow.

3.1 Economic Costs and Benefits

The total dollar costs of buying a binary nerve-gas capability to replace the existing nonbinary one are estimated below to be in the range of $800m–$1400m., perhaps more, RDT & E would account for 15–40% of this, with 60–85% for weapons procurement. If the costs of destroying the existing stockpile are added to this, as they should be, the total costs could rise above $2000m. From this should be subtracted the eventual demilitarization costs of the binary stockpile; but these, according to DoD, are likely to be relatively small.

The timetable would presumably be set by the present state of senescence or obsolescence of the existing nerve-gas stockpile. The Chemical Corps told Congress in Summer 1969 that once a munition has been filled with nerve gas "it can last up to 15 years" (*50*) (bulk stocks of nerve gas are said to last almost indefinitely. (*51*)) Chemical Corps testimony on this matter should perhaps be treated with some reserve, particularly since it is a DoD requirement that any munition accepted for standardization should have a minimum lifetime of 20 years. However, in a Summer 1973 release, the Army's Office of the Program Manager for Demilitarization of Chemical Material (OPMDCM) spoke of 1985 as the estimated completion-date in one set of plans for stockpile demilitarization. (*52*) The youngest filled chemical munitions in the stockpile would by then be 16 years old.[16] It thus seems appropriate to suppose that replacement of the existing stockpile with binaries is envisaged as an 11-year programme. Its costs would thus average out to somewhere in the range $135m–$185m per year.

On demilitarization, the cornerstone in OPMDCM's present plans is a chemical destruction concept in which the disposal apparatus is transported in turn to

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[15] On this, see p. 316 below.

[16] These are the Weteye bombs and Honest John warheads which Rocky Mountain Arsenal were still filling in the Summer of 1969. (*53*) Although they are the youngest, some of them will, ironically, be among the first weapons to be destroyed in the new round of demilitarization activities: they form part of the recently-condemned War Reserve stocks at Rocky Mountain Arsenal. (*54*)

each of the different stockpile locations, rather than moving the stockpiles to a central demilitarization plant. The latter alternative is precluded by the political outcry which it would almost certainly provoke. The transportable disposal apparatus, known as CAMDS,[17] is a modular design capable of being dismantled and transported on railcars. (*55*) It is being developed at Tooele Army Depot, and is planned to become operational by the end of 1978. Army spokesmen have been reported as estimating that total development, construction and operation costs of CAMDS will be about $750m. (*56*) Studies are currently underway to determine whether the VX-detoxification process cannot be made to yield one of the binary chemical components. (*21*) [18]

On R & D expenditure, it is possible to estimate[19] that the stages in the binary development process in which a specific item of hardware is being developed (i.e., advanced development and onwards) have so far consumed at least $15m, primarily on hardware for the 155-mm GB2 and 8-inch VX2 projectiles, but also on GB2 and VX2 process chemistry. Since FY 1972, engineering development of the 155-mm projectile has been running at rather more than $1m per annum, and this will presumably continue until 1977, the year in which the projectile is scheduled to enter the quantity-production phase. (*59*) Thus one may estimate that each new binary munition might cost up to $15m or more in R & D. Since up to twenty or more different munitions[20] will be needed to provide what DoD apparently regards as an adequate nerve-gas capability, a total R & D expenditure (including work on process chemistry, &c.) in the range $200m–$400m seems likely. If the programme is to be completed by 1985, an annual expenditure of $18m–$36m would be required. The total DoD budget for CBW R&D in FY 1974 is $50.35m; (*80*) DoD has said that its FY 1973 expenditure on CBW R&D was programmed at $53.2m (*23*), of which less than $8.3m was in support of binary weapons advanced and engineering development. This suggests that unless a decision is taken to abandon the binary programme, the DoD lethal chemical weapons R&D budget will have to be doubled or quadrupled at least; this would mean a 20%–50% increase in the CBW R&D budget as a whole.

On procurement expenditure, some guidance on the likely costs is contained in the Department of the Army's figure of $246.0m for the "total systems cost" of the 155-mm GB2 and 8-inch VX2 projectiles. This figure was released in March 1973; (*60*) and it included R&D and production-base costs in addition to the procurement expenditure planned for these munitions. One may estimate from the "unit cost" (i.e. procurement only) figures—$36 to $123—for high-explosive and illuminating 155mm projectiles, and their fuzing, (*61*) that binary 155mm nerve-gas rounds would cost about $100 each, taking into consideration their relative complexity. This suggests that present plans envisage the procurement of 1m–2m binary howitzer projectiles (i.e. about 100,000 tons of them, enough to keep twenty artillery battalions going for a month). One may also use the estimated cost of the 155m round as the basis for estimating procurement costs for a complete binary arsenal. Nerve-gas munitions of course vary in their unit cost and in the amount of nerve gas they hold (on this, see the table in Appendix 2), but, per unit weight, the 155mm round is probably representative of per-pound costs of hardware per pound of nerve gas. In Appendix I, it is estimated that the present US stockpiles contain about 40m pounds of nerve gas. Therefore, in order to replace the deterrent capability supposedly represented by these stockpiles with an equivalent binary capability. DoD would need to acquire binary munitions equivalent to about 7m 155mm rounds.[21] The $100 estimated unit cost was for FY 1972 current prices, and is likely to be considerably inflated by 1977–85; allowing for this, one arrives at a total procurement cost in the range $600m–$1,000m, perhaps more.

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[17] Chemical Agent Munition Disposal System.

[18] A similar possibility presumably exists with regard to GB detoxification. There are a number of alternative processes that might be used. One would be to hydrolyse the nerve-gas, extract the methylphosphonic acid from the hydrolysate, and fluorinate it to yield DF. Another, in the case of GB, would be pyrolyse and then chlorinate to yield methylphosphonofluoridic chloride, (*57*) which in some ways (*58*) is a more attractive binary component than DF.

[19] The basis of the estimate is much the same as that described in footnote 8 on page 300 above. As noted there, the estimate seems more likely to be too low than too high.

[20] Twenty or thirty different nerve-gas munitions have been standardized for the present arsenal (see Appendix 2).

[21] The standard 155mm GB round holds about 6 lbs of nerve gas. Although the 155mm GB2 binary round has twice this payload, it does not appear to be capable of engaging a larger target-area; (*62*) indeed, on present evidence, it seems to be appreciably less effective, as is described below.

It thus appears that DoD plans to spend $750m on the destruction of an arsenal of weapons and at the same time to spend up to twice that amount on a new arsenal having precisely the same function. Are there any economic benefits to set against these costs, or do all the supposed benefits lie outside the economic field?

DoD has argued that a move into binaries will promise a financial saving by removing the obligation to maintain the existing nerve-gas production factories. But, except insofar as this may permit DoD to sell off some of its real estate, the saving is unlikely to be great. Despite the expectations expressed to Congress in 1969, there is little sign that the Army will be able to procure all of the binary chemicals from industry; indeed, it is now planning to introduce yet another item into its Operations and Maintenance budget for the DF factory at Pine Bluff Arsenal. As for the GB factory at Rocky Mountain Arsenal, this has now become a central part of the demilitarization operation; and three-quarters of the VX factory at Newport, Indiana, will presumably be used for manufacturing QL (one of the VX2 binary components), just as it was during 1961–67. This leaves only the dichlor factory at Muscle Shoals, Alabama; but the maintenance work there on which a saving might be made currently amounts to no more than a few man-years of work: paint is regularly applied to the outsides of the buildings, but the insides contain plant equipment that has, in many cases, long since fallen into neglect. (*63*)

DoD has, however, also spoken of the savings in stockpile-maintenance costs which the binaries would permit. Because binaries are less likely than nonbinaries to generate storage hazards as they age, they would necessitate less in the way of safety measures and surveillance at storage depots. This is presumably true, but published evidence enabling the savings to be estimated is scarce. A November 1973 press report suggested that the present US stockpiles of nerve gas, at home and abroad, cost about $100m per year to maintain. (*24*)

This seems an improbably high figure, however, when compared with DoD testimony given to the House Armed Services Committee in 1970; according to this, $2.0m was the estimated figure for FY 1971 for "costs incurred in support of CB commodities." (*64*) This figure, which was contained in a presentation purporting to disclose to Congress all the costs of the current CBW programme, came from Program 7S, Supply Depot Operations, of the Army Operations and Maintenance budget. A move into binaries would not, of course, entirely eliminate nerve-gas maintenance costs; the binaries will present their own peculiar storage problems and, as noted earlier, it seems likely that a sizeable tonnage of bulk nerve-gas will be retained.

In fact it seems rather likely that a binary stockpile will be more expensive to maintain than the existing nonbinary one, not less expensive. Much of the present nerve-gas stockpile is in the form of bulk agent, rather than filled munitions (on this, see Appendix I). A binary stockpile would therefore represent a substantially increased number of munitions, and therefore a substantially increased volume of munitions storage-space to maintain.

3.2 Environmental and Safety Factors

In the United States, as in Britain, CBW becomes a subject of widespread popular concern two or three times a decade. Yet at no time since the days of the 1925 Geneva Protocol has this ebb and swell left so permanent a mark as it did in 1969. That was the year in which, under the influence of public opinion, international CB disarmament negotiations began in earnest, and in which the United States and a number of other countries renounced any interest in the further development of biological weapons. The immediate origins of this new wave of popular feeling were undoubtedly to be found in the Viet-Nam war. It was this that brought home to people, horrifyingly, what war fought with modern technology in general, and with CB weapons in particular, was or could be like. It also drew attention to the extent to which military objectives had penetrated and deformed so many different aspects of society, not least the professional world of chemistry and microbiology. Yet this current of feeling about CBW did not acquire much political force until it became linked with environmentalist concerns. Anti-CBW activists and environmentalists found common ground in the images of ecocide presented by photographs of Vietnamese forests laid waste by Chemical Corps herbicides. Environmental legislation and Congressional structures on the US CBW programme proceeded side by side. The Chemical Corps was left in a situation in which several of its normal activities had become either illegal or so constrained by environmental-protection and other safety stipula-

tions as to be virtually impossible. In the former category was chemical-weapons R&D (including, presumably, work on binaries), although for reasons that remain obscure, the legislation forbidding this did not survive for long; in the latter category were the open-air testing and transportation of CB weapons.

Against this background, it is not surprising that the Chemical Corps should have stressed the environmental and safety benefits of binaries. It is clear from the record, if only by implication, that the chemical-weapons authorities within DoD regard the greater part of the precautions that they are now required to take as being excessive and unnecessary in themselves, and a serious obstacle to the adequate fulfillment of the Chemical Corps mission. Binaries represent for them, it might be supposed, a compromise between the demands of national security and the importunities of the environmental lobby, a compromise, moreover, which Congress, as instigator of environmental legislation, has a duty to accept and support.

It is not easy to develop a logic which can accommodate both environmental and security objectives, and for this reason joint assessments of environmental and security considerations are likely to remain at an emotional level rather than a rational one. That is not to say, though, that assessments cannot be made within each of the two areas separately. In many people's view, the case for regarding a peacetime stockpile of nerve gas an essential component of US national security is extremely weak, impelled more by the interests of the Chemical Corps constituency than by any rational military or strategic consideration. (In contrast, the need for an up-to-date CB defensive posture—respirators, protective clothing, alarms, &c.—seems much stronger, under present circumstances; but that is another question.) In the absence of a serious security argument, the environmental argument, whatever its strength, would take precedence by default.

Compared with existing nerve-gas weapons, binaries undoubtedly possess benefits from an environmental and safety point of view. Above all, they would not normally have the capacity for inflicting sudden death on a massive scale. Their manufacture requires one less chemical process, and therefore imposes a somewhat smaller environmental burden as regards waste products and resource-consumption. If accidents should occur during transportation or storage—and, on past experience, they would be extremely rare—the environment would be subjected to a chemical challenge whose impact, so far as is known, would be smaller than that of an equivalent release of nerve gas. But when set against the environmental costs that a full-scale binary programme would impose, these benefits seem less substantial.

The biological hazards of non-binary nerve-gas are extremely great, but those of binary components, although very much smaller as regards acute toxicity, are certainly not negligible. Some of them have already been alluded to. DF, the GB2 ingredient to be produced at Pine Bluff Arsenal, is a chemical whose physiological effects resemble (and probably, for the most part, derive from) those of hydrofluoric acid. As far as lethal effects are concerned, animal experimentation has shown its vapour to be 150–1,100 times less toxic than GB, that is to say comparable in toxicity with chlorine (although its vapour pressure, and hence its lethal hazard, is much smaller: its volatility is much the same as that of water). In an Edgewood Arsenal report, it is described as "extremely pungent and irritating to the eyes and mucous membranes, much like hydrogen fluoride. Persons accidentally exposed to the vapour would seek to escape long before receiving a dangerous dose".(*65*) Edgewood is still conducting its chronic-toxicity evaluations of DF, including mutagenic and teratogenic studies, (*21*) but it seems that any findings to date have not yet been released.

No toxicological studies of QL, the VX2 ingredient, have yet appeared in the open literature, and about the only open information on its toxic hazards is contained in an Edgewood contract report on a quite different matter. (*66*) This was concerned with the flashing of aerosols, including QL aerosols, and the mishaps experienced by the unfortunate experimenters testify to the hazardousness of the substance. The following passages are taken verbatim from the report:

The toxicity and potential toxicity of QL require that due care must be exercised because of the potential hazard. . . . The reactivity of QL with water and oxygen requires that it be protected from the atmosphere at all times. . . . It is incompatible with rubber and plastics except Teflon. . . . The tendency of QL to decompose in storage with an increase in container pressure has resulted in one accident to date. . . . We have noted that there are several physiological effects on personnel using QL. Exposure to the vapour can bring on stomach upset and

difficulty in breathing (described as a "tightness in the lungs"). Skin dermatitis has been noted in the form of an itchy red rash which covers large areas of the body. The dermatitis condition can occur from vapour exposure alone. The intestinal and lung disturbance clears up in a few hours, the dermatitis in a few days, following exposure.

It cannot be contended that these various hazards would over-extend the safe-handling capabilities of Chemical Corps personnel, or even of reasonably-experienced supply and logistics personnel. Nevertheless it is clear that DF and QL are not the "harmless chemicals" which they are portrayed as being by the promoters of binaries.

The greatest environmental and safety costs associated with a full-scale binary programme are likely to be those that will arise during the open-air testing programme. It is significant that the necessity for such testing is, as noted earlier, a subject of controversy within DoD. The Army people involved appear to be arguing strongly for a test programme ("you don't buy a pair of shoes without trying them on", one of them told a reporter recently (*24*)) and they will probably win their case if the binary programme goes ahead. Apart from anything else, they have the embarassing precedent of lewisite to support them. (Lewisite is a powerful vesicant that was first studied in European and American CW laboratories during the closing stages of World War I as a possible replacement for mustard gas. A production-process was hastily developed for it by Edgewood Arsenal, and a shipload was on its way to Europe at the time of the Armistice. On the basis of relatively meagre laboratory studies, and without field testing, it was regarded by the experts as a CW agent of exceptional potency and importance. Little further work was done on it in the United States until World War II broke out, whereupon the Army once again decided to manufacture it in large quantities. Some 20,000 tons had been produced before a full-scale re-assessment of its properties was in hand. It was then discovered during open-air releases that the agent was rapidly destroyed by certain levels of atmospheric humidity, thus rendering it virtually useless.)[22]

Open-air testing has several purposes, in addition to confidence boosting.[23] As the case of lewisite showed, and as described earlier, there can be factors in the open-air environment which may not show up in laboratory studies, or be possible to mimic, and which have a profound effect on the offensive properties of disseminated agents. The agent-dosage fields set up by different munitions need to be measured under a variety of weather conditions: this is necessary for several reasons of which the evaluation of design modifications and the computation of munitions-expenditure tables are among the more important. Again this is something which cannot be mimicked with confidence using simulants. The user Services for whom the weapons are designed are more likely to decide in favour of acceptance if they are shown unsimulated weapons in action, particularly if some sort of bioassay—such as tethered animals—is used to demonstrate effectiveness. A full-scale binary programme would require that these activities continue over a period of eleven years at least.

If DoD eventually decides to authorise open-air binary nerve-gas tests, it will no doubt feel itself justified in arguing that the people concerned will be capable of containing the environmental and safety hazards within acceptable limits. It will certainly contend that the precautions which have been introduced (*69*) in response to environmentalist pressures will prevent a repetition of the incident in 1968, when 6,000 sheep near Dugway Proving Ground were accidentally poisoned with VX.[24] It is to be hoped most fervently that they will be proved correct. If so, it will be an achievement, not only for the Chemical Corps, but also for the people at whose insistence the environmental safeguards were raised above their 1968 level.

In considering the environmental aspects of binaries, there is a wider issue which should not pass unnoticed. Binaries are being presented as a solution to a particular set of environmental problems. Of all the environmental problems

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[22] For a documented account of the lewisite episode, see Volume I of the SIPRI study. (*67*)

[23] A detailed statement on the necessity of open-air testing is to be found in the Congressional testimony of Dr. Emerson, an Army official, before the Reuss subcommittee in May 1969. (*68*)

[24] Since open-air releases at Dugway of lethal agents from large munitions or from high altitudes are now forbidden by current DoD regulations, it looks as though there may be problems in finding a suitable location for prooftests of several of the binary munitions that may be developed—a problem which forced the big biological-weapons trials of the mid-1960s out to sea. The Secretary of the Army is reported as having said, in November 1973, that a "sufficiently isolated" location was being sought. (*70*)

facing the United States today, does the nerve-gas one really have sufficient priority to warrant the purchase of a two-billion-dollar solution?

3.3 Security Costs and Benefits

National security is an abstract notion of extreme emotiveness and diffuseness, meaning different things to different people at different times. These are features which contribute to its great political potency, but they also mean that there are few security yard-sticks or reference-points having sufficient generality for the purposes of the present paper. Yet at risk of tending towards too militaristic an attitude—the equation of national security with military might—two such yardsticks are implicit in the discussion which follows. Thus, the first half of the discussion is concerned with the overall military assets and liabilities of binaries; the second half discusses the relationship of binaries to arms-control objectives, and their likely impact on the present chemical-disarmament negotiations.

3.3.1 Binaries and Military Strength

3.3.1.1 Tactical Aspects: The Relative Performance of Binary and Non-Binary Munitions

No advantages whatsoever can be seen for binaries when a straight comparison is made between them and non-binaries regarding their abilities to provide the weapons effects currently required of nerve-gas munitions. Indeed, their operational effectiveness appears to be considerably inferior on every count. In particular, their effects are even less predictable, and therefore less controllable, than those of non-binaries; the number of tactical situations in which they can be used is smaller; and defence against them is likely to be easier.

A chemical reaction is a dynamic process which takes time to reach an equilibrium. A binary nerve-gas reaction will not reach equilibrium during the user-to-target sequence. Thus the chemical nature of the contents of a binary munition during its target trajectory will be in a state of continuous change. Both the physical and the toxic properties of the payload are determined by its chemical nature. The toxic properties determine the casualty effects of the munition.

The physical properties determine the behaviour of the payload after dissemination, in particular the area of ground covered, and the size, shape and persistency of the aerosol cloud that is generated. These are the principal factors that determine the performance of a chemical munition. In a non-binary munition, under a particular set of weather conditions, they are constants in the overall weapon-effects equations. In a binary munition they are time-dependent variables. This will have major practical consequences for the users of binary munitions. Artillerymen, for example, would have to contend with a situation in which the target effects of binary shell varied according to the range of the target. So also would the hazards to friendly personnel downwind of the target. Given time and sufficient open-air field-testing, munitions expenditure tables could probably be worked out that could cope with all the variables; but their complexity, and the degree of confidence that they would inspire, would be of a similar order to those of biological-munitions tables. The tables for non-binary nerve-gas are complicated enough.

That binaries are appreciably closer to biologicals than to non-binary chemicals in some respects is suggested by the following illustration of what happens in a binary VX munition of the liquid/solid type. The QL/sulphur reaction is strongly exothermic, so that high temperatures are soon reached within the munition, which has little opportunity for shedding heat. Heat is necessary to isomerise the product of the reaction into VX, but too much heat will destroy the VX by thermal degradation. (*13*) Moreover, hot VX degrades particularly rapidly in the presence of sulphur. (*71*) Thus, if the quantity of VX present in the munition—which is to say the number of potentially lethal doses of agent which the munition contains—were plotted against the time elapsing from the commencement of the binary reaction, it would rise quite steeply over the first minute or so, but then, after about half of the theoretical quantity of VX had been formed, it would begin to fall, slowly for a brief initial period, but then with an accelerating descent until, after a relatively short space of time, virtually none remained.[25]

[25] Thinly disguised, but sketchy, time-profiles of the GB2 and VX2 binary reactions have recently been published in a Swedish defence journal. (*72*). They are presumably all that the Swedish Research Institute of National Defence considered proper or prudent to release from its own laboratory studies.

This curve has much in common with the time-profile of the viable-pathogen dosage field set up in the vicinity of a functioning biological munition, and subsequently decaying as the pathogens are killed off by humidity-change, sunlight and other open-air factors. As with the biological munition, the binary VX munition provides only a narrow time-interval during which it can secure a militarily-significant number of casualties; the task of causing this time-interval to coincide with the period during which the target population is maximally exposed will, from an operational point of view, be correspondingly difficult and poorly predictable. Binary G-agent munitions, it must be said, are probably more amenable than binary V-agent ones; but both are needed, according to present DoD logic, in the US nerve-gas capability.

Since the quantity of nerve-gas contained in a non-binary munition is the same, more or less, at whatever point in time the munition is detonated, the limits to its operational utility will be much the same as those of its delivery system. This is not the case with binary munitions. Only for a finite space of time does a binary munition contain active agent, and it is the relationship of that space of time to the delivery characteristics of the delivery system that determines the limits to its operational utility. In some instances there may be complete incompatibility between the two, meaning that the binary concept cannot be used in the weapon-system in question. The VX land-mine is probably a case in point, for here only a very few seconds will elapse between the functioning of the munition and the point at which the target loses vulnerability. For a mortar, artillery or rocket system, the time factor will impose constraints on the ranges over which the system is effective. Thus, if it is assumed that a binary GB2 projectile requires about ten seconds to attain its maximum GB payload after firing (there is DoD Congressional testimony to support this assumption (*22*)), targets closer than ten seconds of trajectory cannot be engaged economically. With VX2 projectiles there would probably be a reduction in maximum range as well. This would mean, for example, that of all the targets against which nerve gas can at present be used from the standard multi-barrelled rocket lanucher, only about half of them would be accessible to binary nerve-gas. It would also mean that binary aircraft weapons such as bombs, clusters or bomblet-dispensers could not be used from altitudes of less than 500 metres or so; binaries would thus have the effect of forcing the aircraft into air-space in which it would be extremely vulnerable to SAMs or anti-aircraft guns. (If, to remedy this situation, the binary reaction were initiated before the weapons were dropped, the timing would have to be such that the binary payload did not enter its decay phase before hitting the target; this would presumably necessitate an unusually elaborate arming system for the weapons.)

The most serious operational shortcoming of binaries, however, probably lies in their unavoidable capacity for increasing the effectiveness of the protective stance of the enemy troops against whom they are used. One of the reasons why non-binary nerve gas is thought to be so potent a weapon is the fact that it is only barely detectable, if at all, by the human senses when present at casualty-producing levels. Even the most modern protective clothing or respirators are useless if their users do not know when to put them on. Ways and means are, of course, being developed to cope with this, notably through the use of automated alarm systems and by having combat troops permanently masked, but there are technical difficulties in the way of the former, and physiological and psychological ones in the way of the latter. The disseminated payload of a binary munition, in contrast to that of a non-binary one, is immediately detectable. The DF of G-agent binaries is, as noted above, a powerful irritant even at low concentrations, and some of it is bound to remain unreacted; moreover, the DF/IP reaction generates not only GB but also large quantities of hydrogen fluoride, and even more potent irritant, to alert people. As for V-agent binaries, the physiological effects of QL noted earlier are bound to give some warning; and, in the liquid/liquid formulation, the second liquid (NM), being a sulphur compound, is almost certain to have a pronounced and highly disagreeable smell. Furthermore, the latter property is also likely to be displayed by the VX-decomposition products contained in the payload disseminated by VX binaries.

The list of military disadvantages of binaries can be extended still further. The greater complexity of binaries compared with non-binaries is likely to mean that failure-rates will be higher. Binary components, especially QL and IP, are in most cases inflammable than the nerve gases; in comparison with non-binary munitions, therefore, binary ones are likely to "flash" more

frequently.[26] Another drawback, primarily with artillery projectiles, is that the non-toxic fragmentation effect of binaries will be substantially smaller. This is because a central burster is precluded in binaries, and because the chemical payload is greater at the expense of fragmentable metal. The fragmentation effect of a nerve-gas shell, although largely superfluous against unprotected troops, is considered important against troops wearing protective clothing and respirators. For the standard 155mm non-binary GB round, it is as much as half of that of the equivalent high-explosive shell. (*73*)

3.3.1.2 Strategic Aspects: The Relative Short-Term Merits of a Binary and a Non-Binary Nerve-Gas Capability

The operational shortcomings of binary munitions are large when compared with those of non-binary ones (which in turn are large when compared with those of non-chemical ones). Certain military advantages can, however, be specified for a binary capability as a whole which a non-binary one does not possess. These are to be found primarily in the area of supply and logistics, where they also have certain wider strategic implications. But in the same area there are also disadvantages peculiar to binaries.

Because binaries are safer to store and handle, they would be easier to move about. Their transportation in and out of supply depots would not necessitate so many precautions as does the transportation of non-binary nerve gas. Supply operations would become correspondingly less troublesome, so that nerve-gas combat operations would become easier to mount and conduct. Still more important, from the DoD point of view, is that the reduced transportation hazards of binaries may lower some of the constraints currently affecting domestic stockpile management. As matters stand at present, DoD has to satisfy a long list of environmental precautions, and risk a political outcry, every time it wants to move nerve gas from one depot to another. This must have had its effect on DoD perceptions of its current strategic preparedness for the eventuality of chemical warfare, even though the constraints can be waived by the President in an emergency.

If binaries could indeed serve to increase the logistical flexibility of the US nerve-gas capability—to relax the rigor mortis which seems to have been setting in since 1969—that would be, in many people's minds, a strong case in their favour. Yet, in addition to the many other costs that would be involved, there would be logistical ones as well. Binaries are considerably less effective in operation than non-binaries, not only for the reasons described in the previous section, but also on a weight-for-weight comparison. This is because the payload of a binary munition, after the binary reaction has taken place, does not consist entirely of nerve gas: it also contains a substantial quantity of by-products and unreacted binary components. DoD Congressional testimony in February 1972 acknowledged this inferiority, if only by implication. (*62*) The binary round holds about 6 kg of chemical, the non-binary only 3 kg; on a weight-for-weight comparison of the chemicals, therefore, binary GB is only about half as potent as straight GB. Moreover, early in 1973, unpublished Edgewood Arsenal reports were being quoted to the effect that, on the basis of chamber trials, the 155mm binary GB round yielded only 75–80% of the integrated area dosage of GB set up by the nonbinary round. If true, this suggests that the relative potency of binary GB is only about 40%. So, in order to secure the battlefield effects of non-binary GB, about two-and-a-half times the quantity of binary GB must be used. (If the comparison is between munitions rather than chemicals, the factor will be rather different, ranging from 1.25 in the case of 155mm rounds to upwards of 3.5 in the case of bombs.) This will necessitate a large increase in the volume that must be given to chemical munitions in the logistical networks.

The increase demanded in shipping space, etc., will in fact be greater still. The whole raison d'être of the binary munition is that it can be shipped in a dismantled state, the munition travelling separately from half of its filling. Thus, not only will more consignments of binary munitions have to be shipped in comparison with non-binaries, but each consignment might need at least 20% more shipping space.[27] Moreover the probability will be increased of one of the

[26] Of course, a munition which flashed too often would probably not be allowed to emerge from R&D until flashing-inhibitors had been developed, or some other solution found; but that would be a process demanding extensive open-air testing.

[27] It can be estimated from official pictures of the XM687 round that the volume of the alcohol canister (which would normally be shipped separately from the projectile itself) is about 23% of the volume of the complete round.

components getting mislaid *en route*, thereby rendering the other components useless and wasting logistical capacity. And even if all the components do end up in the right place, their assembly will require a significant diversion of manpower which, under the circumstances, is likely to be in heavy demand elsewhere.

But the logistics backup given by DoD to its armed forces is immensely capacious and carefully organised; unless the supply channels were stretched to their limits (as, of course, they might well be in the sort of war in which nerve gas was used), these particular costs might not amount to very much. To some people, they would seem trivial in comparison with the improvements that binaries may make in overall U.S. strategic preparedness for chemical warfare. Yet here there is a vitally important, though largely hidden, cost.

The function of the U.S. nerve-gas capability is, according to official policy-statements, to deter the use of chemical weapons by threat of retaliation in kind. A move into binaries might be thought to facilitate that function by easing constraints on forward deployment, particularly during peacetime. Because the retaliatory option would then become easier to execute, it would also become, on this line of reasoning, a more credible deterrent.

This argument is, of course, no stronger than its basic premise, namely that nerve gas is capable of deterring nerve gas; but that is not the immediate issue here. If binaries are to be judged on their deterrent value, it is necessary to recognise that deterrence is a coin which has two faces: the threat and the counter threat. Binaries cannot be accepted as good for deterrence solely because they are thought to enhance the retaliatory capability; their effects on the threat which they are supposed to be deterring must also be considered. Here one may put oneself in the position of the potential enemy, the person who might be considering the use of nerve gas against U.S. forces. If in his eyes the U.S. nerve-gas capability has acquired increased credibility through binaries, that will only be because he perceives U.S. forces to be better able to use nerve gas. But he, like the opposing Americans, will be mistrustful of enemy intentions, perceiving a real possibility of President Nixon's declared CW policy of no-first-use in fact concealing a real policy which did not preclude first use;[28] and the United States, in the eyes of the outside world, is not exactly rushing to ratify the Geneva Protocol. Moreover, on any rational assessment, the offensive value of nerve gas diminishes rapidly after its initial employment, once the element of surprise has been lost and the enemy is in full protective posture. Should the military advantage of using nerve gas first be ceded to an enemy who, through the acquisition of binaries, appears better able to take that advantage? The answer to this question might very well be in the negative. Thus, if binaries can be said to increase the credibility of a like-with-like nerve-gas deterrent, their propensity for increasing the likelihood of deterrence failing must also be conceded.

There is a further dimension to this extremely important consideration. The logistical advantages of binaries relate primarily to peacetime deployment: binaries are attractive because they enable nerve-gas deployments to be adjusted or effected without incurring the political costs of domestic outcry against nerve-gas transportation, costs which would not be significant during a major war. Therefore, if full advantage is to be taken of this feature—and there would be little point in buying binaries if it were not—one must anticipate massive shipments of binaries into those forward supply depots where non-binary U.S. nerve-gas is at present stored, and perhaps others as well. Such activities cannot fail to have serious security ramifications, especially where they affect West Germany. Even though the shipments might represent nothing more than stockpile substitution, they would be perceived by the outside world, not merely as a significant military build-up by U.S. forces in Europe, but also as a major build-up in offensive chemical-warfare capabilities. And this will take place against a background of the present diplomatic endeavours for reducing tensions and military forces in Europe.

The likely effects on the Warsaw Pact negotiating stance at the force-reduction and European Security talks are clear enough. And, in addition, there would be some probability of the Warsaw Pact embarking upon a corresponding build-up in offensive chemical-warfare capabilities. Thus, if nerve gas in the hands of potential enemies does indeed represent a significant threat to U.S. security, a move into binaries might not only increase that threat, but also compromise other security-enhancing endeavours.

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[28] Such was the situation in US chemical-weapons policy from 1934 to 1942, according to information contained in Colonel F. J. Brown's book. (74)

3.3.1.3 Further Strategic Aspects: Proliferation and Other Long-Term Considerations

In renouncing the option of using chemical weapons first, the United States has acted in its own best interest. This is true, not only for its moral and humanitarian stance in the world, but also for its relative military strength. When set against the vast array of armaments, nuclear and non-nuclear, at the disposal of U.S. armed forces, it is clear that nerve gas is of only marginal value to the United States. Yet nerve gas is an instrument of enormous destructive power, not incomparable with that of fission weapons, and probably a lot cheaper. It could therefore be attractive to countries who might wish to reduce the disparities in their military strengths vis-à-vis the United States. One of the reasons, it may be recalled, why the United States became seriously interested in nerve gas in the early 1950s, when nuclear weapons were still in their infancy, was as a means for compensating against military manpower inferiorities: the "human wave" assaults by Chinese forces in Korea had made a lasting impression on the U.S. Army. Unlike most countries, the United States now has other means for rectifying this sort of disadvantage. But there have been other changes since the time of Korea: the United States has become very much the leader of technological fashion in the military world, so that if it were to have maintained a first-use option in nerve gas, other countries might sooner or later have decided to do the same. If this were to happen, it would inevitably weaken, to a greater or lesser extent, the relative military strength of the United States in the world, and therefore, to some degree, its national security also.

The point is not so much that proliferation of nerve gas might endanger the population of the United States. Rather it is that in those areas of international relations where there is a role for US military strength—whether as symbol, threat, counterthreat, or actuality—that role will be weakened. Whether the proliferating nerve gas is serving as an instrument of regular warfare, of strategic threat, of guerrilla action, or merely as a bolster to illusions of national grandeur, its overall effect on US security, conceived in military terms, will be much the same. Neither is the concern solely at an international level; nerve gas in the hands of intranational dissidents may also be a threat to the US Government or, more especially, to a client government. Since the proliferation of nerve gas at any level would be against US interests, that also is a criterion against which a move into binaries must be judged.

One does not need to go into any detail at all to illustrate the capabilities, and their attractions, which nerve gas could place in the hands of violently-militant dissident groups. Neither does one need to look any further than the BW-blackmail episodes (all of them abortive) in Stanford (1969), Chicago (1972) and Hamburg (1973) to see how imminent the possibilities may be. In principle, nerve gas has been available to dissidents since 1950, the year in which detailed laboratory procedures for its preparation were first reported in the specialist chemical literature. But this did not provide much accessibility, primarily because the procedures described would have had to be performed by skilled chemists in well-equipped laboratories if they were not to kill their operators. It is clear from the experience of, for example, Northern Ireland (particularly the types of explosive favoured) that skilled chemical expertise is not readily accessible to dissidents. But the appearance of binaries could well change this situation, in two ways.

First, since there is likely to be more movement of binaries around the United States (and perhaps eventually around Europe also) than there has been in the case of nonbinaries, the probability of some of the chemicals escaping or being extracted from military channels will be increased. Second, and more important, the publicity given to binaries may draw attention to their possibilities, encouraging emulation of the achievement of the Chemical Corps in providing a weapon that is less likely to kill its producers or users. This possibility has recently acquired a substantially increased immediacy with the appearance as industrial commodities of certain chemicals that can serve as nerve-gas intermediates—intermediates that would otherwise have required two- or three-stage preparative processes in a laboratory. One such chemical, ethylphosphonothioic dichloride, is now produced in the United States in quantities exceeding a million pounds per year (primarily as an intermediate for new types of pesticide, such as fonofos). It is not itself a binary component; but it is only one very simple and safe chemical step short of this.

For nerve-gas proliferation at an international level, a major precondition is that the countries in question be economically and technologically capable of manufacturing nerve-gas weapons on a large enough scale to have military significance. The ease with which this can be done will be determined by existing capacity for large-scale manufacture of relatively complex organic chemicals. The specifics do not need to be explored here. It is sufficient to note that the detailed studies which have been made of the question indicated that the cut-off point separating countries whose production base is adaptable to the manufacture of nerve gas, within a year or so, from those countries which do not have this ability occurs towards the upper end of the scale of industrialisation.

In one such study, Argentina was judged capable whereas India, Egypt and Israel were not. (*75*) There is good reason for supposing that binaries would push the cut-off point an appreciable distance down the scale. In particular, there is the fact that binaries would not necessitate heavy investments of capital, skilled labour and technological expertise in the handling of super-toxic chemicals in bulk quantities. With the elimination of this requirement, access to nerve gas via domestic factories presents no greater problem than access to, say, an organophosphorus plasticizer or pesticide. Even within the United States chemical industry, production of nerve gas *per se* proved no easy task; and it is particularly relevant to note here that DoD told Congress in June 1969 that a move into binaries would mean that the limiting factor in the rate of nerve-gas weapons production would cease to be the rate at which chemical agents could be manufactured; it would instead become the rate at which munitions could be fabricated, a much lesser obstacle. (*20*)

Munitions-fabrication capabilities have already proliferated rather extensively around the world, not least to India, Egypt and Israel. The only impediment that can be placed in the way of a corresponding proliferation of binary production capabilities is nondissemination of the data from which design specifications can be drawn up. But much is already available from the US patent literature; and it is inevitable that once large-scale fabrication of binary munitions gets under way in the United States, there will be a rapid dissemination of still more data. Stringent security precautions may delay this process, but time and human ingenuity are against them.

One way of illustrating just how major an obstacle to proliferation is being removed by the development of binary technology is to compare the construction costs for the chemical-agent factories that the US Army needed to build in order to make nonbinary GB with the appropriations which it is now seeking for its binary GB plant. The figures, at today's prices, are $225m for nonbinary GB (see Appendix 1 for details) and less than $5.8m for binary GB. There are two reasons for this great difference. One is that the binary programme is bringing into existence, for the first time, a commercial source for a crucial intermediate, dichlor, so that the Army no longer has to make its own; in the mid-1950s, when the nonbinary GB was being produced, dichlor production was beyond the competence of the US chemical industry.[29] The second cause is the one referred to above, the elimination of the need for expensive safety measures. The two factors can be separated from one another by comparing construction costs for the binary and the nonbinary chemical production plant that is required beyond the point where dichlor has entered the production process. Since dichlor is to be an input material for the binary plant at Pine Bluff Arsenal, the binary figure will remain the same, but the nonbinary figure drops to $38m (at today's prices). Thus, for countries with access to a commercial source of dichlor, the removal of the requirement for extensive investment in safety precautions lowers the necessary plant construction costs by an order of magnitude.

The increased accessibility, through binaries, of nerve-gas capabilities may very well arouse the interest of countries which have previously paid little attention to chemical warfare. It may also arouse concern lest potential enemies exploit the new situation to their advantage.[30] The ground would then be set for a new type of arms race which, if it occurred, would represent not

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[29] Developments in the US organophosphorus pesticide industry explain why the situation has now changed. A factory that is capable of producing the ethylphosphonothioic dichloride referred to above is also capable of producing dichlor with very little modification of plant installations. And it is apparently from the one factory that is at present producing this particular pesticide intermediate that the US Army plans to buy its dichlor.

[30] The military commonly make threat assessments on the basis of what they think potential enemies are capable of doing, rather than on what they are actually doing. If it is perceived that a potential enemy is capable of making a new type of weapon, there is a strong tendency to assume that he has actually done so.

merely proliferation of nerve gas, but an accelerating proliferation. The likelihood of this happening, however, would also depend on certain other factors. In particular, questions of assimilation would enter into the relevant decisions: would Service authorities in the countries concerned actually want nerve gas, and if they did would they in fact be capable of using it, or at least of bringing their commands to a state of readiness to use it?

The assimilation of new weapons by armed services is dependent upon a complex array of social, psychological and technological matters, in addition to military ones. But these are not in fact of immediate concern here, for the question to be answered is whether binary nerve gas is more assimilable or less assimilable than nonbinary nerve gas. In a different guise this question has already been discussed, in relation to the US armed forces. The proposition that binaries would increase the credibility of the like-with-like nerve-gas deterrent rests on the notion that US armed forces would be better able to use, or adjust themselves to use, binary nerve-gas than non-binary nerve-gas; it is therefore a proposition about assimilation. To the extent that it is valid, binaries are more assimilable than non-binaries.

Accessibility and assimilability are not completely independent of one another. It seems that in most industrialised countries, the weapons acquisition process is governed, not only by the pull of military requirements, but also by the push of weapons technology: the availability of a new type of weapon may act as an incentive to acquire it. Accessibility can spur assimilation. For this reason one may conclude that binaries carry a very real risk of promoting the proliferation of nerve gas as a quasi-conventional weapon.

3.3.2. Binaries and Arms Control

Arms control, as an element of US security policy, has had a somewhat chequered history, and even now, in the days of SALT, the real importance given to arms control objectives in US policy-making is by no means clear. Nevertheless, through innumerable public statements from the President and downwards, the United States is committed to arms-control negotiations. Since the pursuit of arms-control is therefore an established part of US foreign policy, and since the United States is currently involved in chemical-disarmament negotiations, it is necessary to explore the arms-control implications of the binary programme.

As currently conceived by US policy-makers[31] the principal function of arms control is to restore stability to international relations destabilized by developments in military technology. Arms control is thus seen as a means for mitigating some of the adverse consequences of resting security on military strength. The main preoccupation, naturally, is with nuclear weapons and the Soviet Union; and the attitudes towards arms-control that have been developed against this background seems to pervade US negotiating policy in all other areas of arms control.

The concept of arms control as a prop to military strength—as a product, rather than an implement, of détente—has meant, apparently, that military considerations have automatically taken precedence over arms-control ones in the present chemical disarmament negotiations. Implicitly, the position of the US Administration (insofar as it has fully explored the matter, which there is reason to doubt) has been that the dangers of chemical weapons for national security can best be countered by a military posture of like-with-like deterrence. The alternative position has not so far been favoured of joining in international chemical disarmament. A policy decision in which it was favoured would have radical implications, for it would elevate the security role of arms-control to that of an alternative, not merely a complement, to military strength. The consequences of creating such a precedent could be far reaching. In public the US position is, understandably enough, presented in rather different terms: international chemical disarmament will not provide the security benefits conferred by the existing posture of like-with-like deterrence until procedures have been agreed upon which will give an adequate degree of assurance that chemical disarmament will actually take place. The technical and political difficulties of agreeing upon such verification are thus portrayed as the primary obstacle to chemical disarmament. There can be little doubt that for those

[31] See particularly President Nixon's 1973 report to Congress on *US Foreign Policy in the 1970's*.

people who equate security with military strength it is a real and genuine obstacle, even though it may not be the primary one.

The current US negotiating position on chemical disarmament has its obscurities, but it seems to imply that verification procedures would be acceptable if they provided no less a degree of security than the current nerve-gas deterrent. Yet it is a decidedly moot point whether a nerve-gas deterrent in fact provides any security at all. The only detailed justification so far put forward by DoD in support of a retaliatory capability is not in fact about deterrence at all; it is about nullification of battlefield disadvantage in the event that deterrence fails. It states that the reason why nerve gas is necessary is in order to be able to impose the same mobility-burden on the enemy as US forces would have to bear if they were forced by nerve gas into full protective posture. (*76*) The implication is that neither side could hope to gain very much from nerve gas once both sides had fully mobilised the defences which are currently deployed. The further implication is that, since both sides will have protective equipments at their disposal in any event, nerve gas is militarily valuable only if it is used first, while other side is still in intermediate protective posture. Since the user is likely to adopt a full protective posture in order to shield himself from his own gas, if he uses it on a large scale, retaliation in kind would not be an effective response. Thus, all that a retaliatory capability can hope to deter is the use of nerve gas in pursuit of military objectives so trivial that army-wide adoption of full protective posture by the user would be more trouble than it would be worth. Can a retaliatory capability whose only practical effect may be to increase the scale on which enemy forces might decide to use nerve gas be considered any sort of asset to security?

This line of reasoning suggests that, far from being a mere substitute for chemical deterrence, chemical disarmament can offer considerably more in the way of security. In place of a counter-threat, probably an ineffectual one, it offers the possibility of removing the threat altogether. Within the limited context of US-Soviet relations, the break-even point at which a chemical disarmament agreement would begin to become more valuable, to both parties, than a military posture of chemical deterrence would be an agreement which provided for nothing more than the destruction of existing chemical-weapons stockpiles.

The additional inclusion of any sort of provision for constraining resumption of production would raise the agreement above the break-even point—provided, that is, the agreement did not constrain deployment of chemical protective equipments. If one side subsequently decided to resume production of chemical weapons, it would certainly affect the other side's sense of security, but reciprocal resumption of production (rather than, say, an improvement of protective posture) would be a response no more logical than is the present notion of maintaining stockpiles as a like-with-like deterrent.[32]

On this analysis, and within this geopolitical region, verification procedures a great deal less onerous than those implied as necessary by the US delegation at the CCD would still be capable of satisfying true US security requirements. Even now it is generally accepted that the current US negotiating stance would be accommodated by verification procedures having a less than 100% chance of detecting illicit production. The present analysis suggests that, vis-à-vis the USSR (and vice versa), anything having a greater-than-zero chance ought to be acceptable, provided destruction of existing stockpiles could be adequately assured.

Outside the field of direct US-Soviet relations, however, the verification requirements may need to be rather more stringent. The Middle-Eastern situation, for example, is one in which antigas protective equipments are not widely deployed, meaning that the incentives for a belligerent to acquire and use chemical weapons could become considerably greater than they are in Europe. Moreover, in confrontations which do not take place under a nuclear umbrella, chemical weapons could represent very much greater threats to national security than they do to the security of the United States. However, verification in regions of the world where industrialisation is relatively low could be conducted in a much

[32] In reality, probably, the stockpiles continue to be maintained more for historical reasons than strategic ones. They were built up, originally, in the prenuclear era, at a time when chemical weapons meant considerably more than they do today to the great powers. Once in existence, they attracted and sustained their own constituency; and it is a well-known fact of life that established institutions tend towards self-propagation. Rationalizations for the status quo fit better into bureaucratic life than do moves for radical excision.

more efficient, and perhaps less intrusive, a manner than it could against a background of large and multifarious chemical industries. Since it is in the interests of the United States to prevent nerve-gas proliferation, these less direct verification problems should be taken into consideration in the US negotiating position.

Binary weapons are, in effect, miniaturised nerve-gas production plants. The problems which they represent for verification are therefore analogous to those of mothballed nerve-gas factories, with the important exception that their locations will not be easy to detect by any form of extraterritorial surveillance (active factories are not easy to detect either). Most of the verification procedures which have so far been proposed will thus have great difficulty in establishing whether binaries do or do not exist within a particular country. The appearance of binaries has therefore had the consequence of removing much of the value from existing verification studies; it has necessitated an expansion of these studies into areas that have not been extensively explored. Field-testing is one such area; troop-training is another.

The one verification technique which the appearance of binaries has left unscathed is the economic-data monitoring approach based on phosphorus accounting. The technique therefore merits renewed study. It was originally developed by the Midwest Research Institute for the US Arms Control & Disarmament Agency, and has since been explored by an East-West working group of experts convened in Stockholm by SIPRI. (77) Despite its shortcomings, the technique seems to hold out the greatest prospects of success in meeting, in an economical manner, the relatively limited verification requirements posited above. (It would not of course provide stockpile-destruction guarantees; but these are in any case more a matter for trilateral negotiations between the USA, the USSR and France.) The contentious issue at present, of course, is the international element in the scheme. On current showing, the USA would require that accounting records compiled at national levels be accessible to challenge audits by an international group; and the USSR would hold that international challenge-auditing would suffice. The Soviet position is logical enough, within the limited context of US-Soviet affairs, but it seems distinctly unambitious: Soviet security would surely gain more than it would lose from so circumscribed a form of international inspection.

As far as verification is concerned, binaries have already done most of their damage. Even if the US binary programme does not go ahead, the fact that binaries are now known to be technically feasible will mean that a lower degree of confidence will be accorded to certification procedures that cannot accommodate them. The difficulties here are compounded by the fact that the binary concept has opened the way to the use of CW agents, not necessarily organophosphorus ones only, whose candidacy might before have been rejected on grounds, for example, of instability; this means that still more attention must be given to the various definitional problems relating to the scope of an agreement. Disarmament negotiations will become correspondingly harder.

As far as arms-control objectives are concerned, the only thing that can be said in favour of binaries is that, because they can be acquired more quickly than nonbinaries, countries may feel less nervous about the consequences of potential enemies abrogating a chemical-disarmament agreement; they may therefore be more ready to enter into the agreement. But the opposite side of this particular coin is that binaries will also make abrogation easier.

Be that as it may, these considerations are trivial in comparison, with the main impact which the US binary programme, if it goes ahead, will have on the chemical disarmament negotiations. At the moment, rightly or wrongly, the United States is not credited by its CCD colleagues with a constructive attitude towards the negotiations. If it were now to initiate a billion-dollar nerve-gas weapons acquisition programme, what confidence could remain in US good intentions? A decision to go ahead with binaries would surely mean the end to the disarmament negotiations, and with them a prospect for improving US security to a far greater extent than binaries ever could.

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Appendix 1.—The Size of the United States Nerve Gas Stockpiles[1]

In CB Weapons Today (Stockholm, London and New York, 1973), which is Volumes II of SIPRI's *The Problem of Chemical and Biological Warfare*, I estimated that the amount of nerve gas available to US armed forces was in the range 15,000 to 30,000 tonnes of agent. My estimate was based on reference material available in the Spring of 1972. Although the actual figure remains classi-

[1] Revised and expanded version of an earlier paper, *The Magnitude of the U.S. Nerve-Gas Capability*, dated 9 October, 1973.

fied information, data have since been released from official sources which seem both to confirm the estimate, and to narrow down the range.

It now appears that total US production of nerve gas amounted to about 50m pounds, of which about 80% was GB and 20% VX. Of that 50m pounds, about 20%, mostly GB, has since been destroyed (or scheduled for destruction), dumped in the sea, or otherwise consumed. When the scheduled detoxification operations at Rocky Mountain Arsenal are complete, it seems, then, that about 40m pounds will remain. There are, however, contradictions among the pieces of evidence, some of which are more reliable than others, on which these estimates are based. There are grounds for supposing, for example, that the present stockpile could be as large as 100m pounds or as small as 30m pounds. The balance of plausibility, however, seems to support the 40m pounds figure.[2]

Part of the stockpile is deployed overseas. A tentative estimate is that there are about 2m pounds on Johnston Island in the Pacific, and about 12m pounds in Western Europe. A substantial part of the stockpile has been filled into munitions. Munitions filled with nerve gas have a shelf-life which is variously estimated at between five and fifteen years; some of the munitions in the stockpile are already nearly 20 years old (see Appendix 2) and are being "demilitarized". The proportion of the stockpile that, at the time of writing, is stored in bulk containers appears to amount between 10% and 60% of the total, probably towards the lower end of the range.

The presentation which follows is divided into two sections. The first deals with the scale and chronology of nerve-gas production in the United States. The second deals with the deployment and consumption of that nerve gas. They rely heavily on two recently-released sources of information. One is a study of past operations at the US nerve-gas factories; this is an historical account based on official sources that was prepared by the Midwest Research Institute (MRI) under contract to the US Arms Control and Disarmament Agency. (*1*) The other is Congressional testimony submitted by the Department of Defense during October and November 1973 to a subcommittee of the House Armed Services Committee. (*2*) Other recent sources relied upon include newspaper articles, and speeches by US Congressmen.

1. Production of Nerve Gas

The MRI study referred to above was scrutinized within the Department of Defense prior to release as an unclassified document, and it is clear that substantial deletions were made on security grounds. Nonetheless, by correlating some of the data that survived this "sanitization" process with other facts and figures released into the public domain by the Department of Defense, one may make quantitative estimates (as is done below) of the total US nerve-gas stockpile.

The page references given in parentheses in the text are to the MRI study. (*1*)

1.1. US Production Capacity for GB

It seems to have been in 1947 that the US Army Chemical Corps (as it was later to be called) developed firm plans for the production of GB (p. 4). Support for these plans appears to have been provided by the report of the Stevenson Committee to the Secretary of Defense in June 1950 (p. 1). In July 1950, or thereabouts, Congress approved an Emergency Bill for Chemical Corps Construction that authorized the expenditure of $31m for the construction of a GB plant, the funds being earmarked for Rocky Mountain Arsenal (RMA) near Denver, Colorado (p. 71). Its production capacity was to be "several thousand tons per year" (p. 59). Substantial additional funding for "initial design, engineering and construction" was furnished from contingency monies available to the Secretary of Defense. (*3*)

The process selected for the production of GB was the five-step DMHP process, on which much information had been obtained from Germany. Plant for conducting the first three steps was built on the TVA reservation in Alabama, hard by the TVA phosphorus extraction furnaces, and became known as the Muscle

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[2] It is reckoned that inhalation of about one milligram of GB or 0.4 mg VX is enough to kill a man. If the 40m lb. estimate is correct, the present stockpile thus contains about 25 million million lethal doses of nerve gas. In terms of munitions-expenditure in tactical operations, the stockpile would suffice to engage a total target area of about 25,000 square kilometres.

Shoals Phosphate Development Works (MSPDW). Construction began in Spring 1951, but it took until mid-1954 to get a smooth output of the GB-intermediate dichlor. The last two steps of the DMHP process were conducted at RMA. Construction of the necessary plant was completed at RMA in the latter part of 1952.

During the construction and shake-down of the two plants, the overall production capacity was substantially increased over the original design, the pace being set by refinements made at RMA. By the end of 1955, MSPDW had reached 270% over design (p. 58). According to the MSPDW historical report for 1957, the "designated dichlor mobilization rate" was then 30,000 tons[3] per year (p. 12). This would correspond to a GB production of 30,000 tons per year (i.e., 100 tons per day for a 300-day operating year). This suggests that something of the order of 10,000 t/y had been envisaged in 1950.

Some sort of military consideration presumably underlay the 30,000 t/y mobilization figure. The MRI study has this comment: "Of course, the initiation of chemical warfare at some future time could undoubtedly result in a requirement for nerve gas far in excess of the thinking and budget limitations of the 1950's and 1960's" (p. 13).

1.2 Actual U.S. Production of GB

The relevant quantitative information contained in the MRI study is shown in the following chronology:

1952.—The pilot-plant for DMHP-process steps IV and V completed at RMA early in 1952; it had a capacity of about one ton per day (p. 61). By the Spring of 1952, it had produced about 28 tonnes of GB for field-testing purposes (p. 60).

The dichlor needed as step IV input was produced by the AFC process in a Shell Chemical Company plant at RMA. This had been completed in pilot form early in 1952 (p. 61) and derived from process development work by the TVA at MSPDW. It was run at a rate of about 7½ tons per day (p. 34).

By the end of 1952, the main GB plant at FMA had been completed and was ready for trial runs. These were delayed by the inability of MSPDW to supply the necessary dichlor.

1953.—Trial runs of the GB plant commence at RMA using dichlor from the Shell APC plant. It is stated in the MRI study that the step-III plant at MSPDW was "operating good" in May 1953 (p. 39), although elsewhere (p. 9) it is stated that no dichlor had been produced at MSPDW before September 1953.

1954.—By mid-1954, MSPDW had been put into reasonable shape by CmlC RECOM, and large-scale production of dichlor was now possible. A July 1954 issue of a chemical trade journal announced that production was due to begin later that month. It quoted Army estimates that something like 3,000 tons of by-product phosphoryl chloride would be generated during July, August and September. (4) Step III of the DMHP process generates about 2.8 tons of this material for each ton of dichlor produced (p. 12). Thus, planned production of dichlor at MSPDW during July-September was about 1,000 tonnes.

By the end of the year, the trial runs of the RMA plant had produced a total of 456,655 gallons of GB (p. 67), i.e. about 1,870 tonnes. At this early stage in the plant's operations, the dichlor-GB conversion efficiency was about 70% (it later rose to 95%) (p. 72), which means that the total production would have consumed about 2,550 tonnes of dichlor. It is stated in the MRI study (p. 67) that this dichlor came from the site's APC plant, but as this would suggest that the APC plant had been run for a total of 373 days (or that it had been run at more than 7½ tons per day) it seems likely that dichlor output from MSPDW was also used.

1955.—Expenditure for 1955 on dichlor production at MSPDW was $6.92m (p. 30). Specific per-pound cost figures are not quoted in the MRI study. It does, however, note that: "at the close of 1955 . . . the cost of dichlor [had been lowered by expansion of capacity] to about $0.36 per lb." (p. 11); and "In 1955 the estimated production cost per pound was reduced 23% from the estimated cost in 1954" (p. 30).

At RMA a test programme was begun in April to "round out" the production venture. There were two test runs during the year (during April to September, and during October), in the course of which the plant capacity was substan-

[3] The "tons" used in the MRI study are presumably the short tons (2,000 lbs) favoured in the United States. A tonne (metric ton .i.e., 1,000 kg) is about 0.91 short tons.

tially increased. No figures are available for the total GB output from these two runs.

1956.—Expenditure for 1956 on dichlor production at MSPDW was $5.95m (p. 31); this was said (p. 31) to represent a decrease of $0.03 per pound in the cost of dichlor.

At RMA, test runs 3 and 4 of the round-out programme were in progress during the first quarter of the year. Both involved heavy production of GB, run 4 being the plant's "proof test"; the dichlor-GB conversion efficiency was substantially increased (p. 68). Later in the year, a series of three normal production runs began. These seem to have been on a smaller scale, and involved only one production line. They ended in August 1957, a total of about 5,000 tons of GB having been made in the three runs (p. 69). No figures are available for the output of the earlier test runs.

1957.—For dichlor production at MSPDW, which ceased in July 1957, the year's expenditure was $3.07m; the scale of operations was smaller than before, raising the cost of the dichlor to about $0.80 per lb. (p. 32). This means a total dichlor production for the year of 1,740 tonnes. Production operations at RMA ended in August 1957. Development work has continued at intervals since then (using, for example, dichlor produced by the HTM-Pyro process), but no information is available about the scale of GB production involved.

Only for 1957 is it possible to derive a figure for the tonnage of dichlor produced during the year from the figures quoted for annual production costs. For the other years, the necessary per-pound cost figures can be obtained from the information quoted only in the form of broad ranges between upper and lower limits. These are shown in Table 1 (where the assumption is made that the 1953 per-pound cost was within the range for 1954) which sets out estimated dichlor production figures.

TABLE 1.—DICHLOR PRODUCTION, 1953-57

[In U.S. dollars]

Period	Dichlor cost per pound	Expenditure on dichlor production (millions)	Quantity of dichlor produced (tonnes)
1953-54	$0.47-$1.08	$2.65-$6.07	2,550
1955	.36- .83	6.92	3,780- 8,710
1956	.33- .80	5.95	3,380- 8,150
1957	.80	3.07	1,740
Total, 1953-57		[1] 18.59-22.01	11,450-21,150

[1] Say 20.3.

It is a reasonable assumption that all of the dichlor produced was, sooner or later, converted into GB. As noted in the chronology, the dichlor/GB conversion efficiency rose from 70% to 95% during operations at RMA, the major improvement being made during the big proof-test run of 1956. In other words, the average yield of GB was in the range of 0.78-1.00 tonnes per tonne of dichlor, probably nearer the upper end of the range than the lower. This would mean, on the basis of the range of figures given in the last column of Table 1, a total output of GB in the range 9,100-21,150 tonnes.

To narrow this range down, one may look first at the data available in the MRI study on GB production costs at RMA. Table 2 below is reproduced from the study (p. 88).

TABLE 2.—*Summary of GB Costs at Rocky Mountain Arsenal*

Period and activity	*Millions*
1950-52: Plant design, construction and pilot studies	$23.8
1953-54: Operational cost (personnel, maintenance, and operational material, plus filling operations)	4.2
1955-57: Operational cost (personnel, maintenance, and operational material, plus filling operations)	3.5
1950-57: Total, including filling and related operations	31.5
1950-57: Total, excluding filling and related operations	26.5

No details are available of the costing procedures on which the costs quoted in the MRI study are based. Do they, for instance, include R & D and construction costs in addition to plant-operation costs? From 1951 to 1957, MSPDW consumed something like $115m, including construction and modification costs (p. 33); a sizeable part of this must have been disregarded, so it seems, in the dichlor cost figures quoted in the MRI study. Table 3 sets out one approach to costing the GB produced during 1952–57:

TABLE 3.—*Cost of the GB Produced During 1952–57*

Item	*Millions*
Dichlor intermediate: Total from Table 1	ca. $20.3
RMA costs, excluding filling operations: from Table 2	26.5
Total	ca. 46.8

No per-pound cost figures for GB are quoted in the MRI study. It is, however, stated on p. 72 that, by the end of operations at RMA, the cost per pound of GB had been "cut in half". This statement may be set against Congressional testimony given in June 1969 by Dr. D. M. MacArthur, a Department of Defense witness. He was asked to give "some of the range of cost on [chemical and biological weapons]". He responded as follows: "The nerve agent GB is $1 to $2 a pound. VX is $2 to $3 a pound." (*5*)

It is difficult to know what sort of weight should be attached to these statements. One interpretation is that, at the start of operations at RMA, GB costed out at about $2 a pound, falling to $1 per pound at the end of operations or during the period of maximum production. On this basis, an expenditure of $46.8m—the total reached in Table 3—would have bought a GB tonnage in the range 10,600–21,200 tonnes. The details of GB production given in the chronology above suggest that, averaged over the period 1952–57, the per-pound cost figure was probably less than the midpoint of the $1–$2 range, thus suggesting a total GB production in excess of 15,900 tonnes, but some way short of 21,200 tonnes. A figure of about 18,000 tonnes would be consistent both with this, and with the range calculated on the basis of dichlor output. If it were correct, the chronological details of GB production given earlier may be summarised as in Table 4 below.

TABLE 4.—*GB Production, 1952–57*

Period	*Estimated GB output (tonnes)*
1952	28
1953 and 1954	1,870
1955 to mid-1956	11,000
Mid-1956 to mid-1957	5,000
1952–57	18,000

18,000 tonnes of GB is about 40m lbs., and rather less than 4.5m US gallons.

1.3 U.S. PRODUCTION OF VX

The Chemical Corps had begun serious planning for the large-scale production of a V-agent nerve gas by 1956 (p. 76). After extensive process studies drawing heavily from earlier British work, a $13.2m contract for the construction of a VX plant on the site of the old AEC heavy-water plant at Dana, Ind., was let in 1959 (p. 86). Construction of the Newport Chemical Plant (NCP), as it was called, and of its ancillary munitions-filling plant, was scheduled for completion by July 1961 (p. 84). In contrast to the GB production operation, the intermediates needed for VX were to be manufactured at NCP. The schedule was kept, and from 1961 onwards varying amounts of VX were produced at NCP on demand. Step III operations (actual VX production) ceased in 1968; steps O, I and II had been shut down in 1967.

The MRI study gives no indication of the maximum VX production capacity at NCP. It must have been large—many times greater than the actual VX output—to judge from the photographs of the plant that have been published. Table 5 summarises the costs of NCP. It is taken from the MRI study (p. 88).

TABLE 5.—*Summary of VX Costs at Newport Chemical Plant*

Period and activity	*Millions*
1959–61 Plant design, construction and pilot studies	$24.2
1961–65 Operations and step III construction modifications	1.0
1965–67 Operations	0.4
1959–67 Total	26.4
1959–67 Total, excluding filling-plant costs	25.0, say*

*The MRI study gives no filling/production break-out.

The MRI study states that the estimated cost of VX in late 1960 was about $2 per pound (p. 87). The June 1969 Congressional testimony of Dr. MacArthur referred to above gave a cost figure for VX of $2–$3 per pound. (*5*) The costing procedure on which this was based was presumably the same as that for his GB per-pound cost figure.

If it is assumed that VX cost on average about $2.50 per pound to produce, the total costs shown in Table 5, excluding the guesstimated munitions-filling costs, suggest that something of the order of 10m pounds of VX were produced during 1961–68.

This assumes that such things as raw-material costs are included in the Table 5 figures. If they were not in fact taken into account in the MRI study, the figure of 10m lbs would be too low (although not perhaps by very much: 10m lbs. of VX would not require more than about $0.3m-worth of elemental phosphorus, the costliest of the raw materials involved). Also, figures published by the General Accounting Office indicate that DoD spent $35m on the procurement of lethal chemical weapons between mid-1964 and mid-1969. (*6*) Although most of this expenditure presumably related to munitions hardware, it does suggest that rather more than $1.5m may have been spent on the construction and operation of the NCP munitions-filling plant.

2. CONSUMPTION AND DEPLOYMENT OF NERVE GAS

No firm information is available on the proportion of the nerve-gas that was produced during 1952–57 and 1961–68 which remains stockpiled in the United States. Disregarding the various allegations that have been made that nerve gas was used during combat operations in Indo-China,[4] there have been three main types of consumption: (a) field testing and related activities; (b) deployment overseas; and (c) destruction of obsolete or deteriorating munitions.

One might guess that field testing, routine surveillance of stored munitions, and so forth, must have consumed some hundreds of tons of nerve gas.

As regards overseas deployment, official US sources have referred only to stockpiles in West Germany and Okinawa. One might have supposed that, in line with current NATO deployment-policy for Europe, there would also be stocks in, for example, Norway and Italy; but DoD statements on this matter deny the possibility. In September 1971, the last of the Okinawa stocks were moved to Johnston Island, in mid-Pacific. According to press reports that quoted DoD spokesmen at the time, the total quantity of munitions moved out of Okinawa was 13,243.7 tons, of which 2,056.6 tons were filled with VX, 8,321.1 tons with GB, and the remainder with mustard gas. (*7*) If it is assumed that the chemical fill accounted for 10% of the weight of these munitions, aboot 1,000 tons of nerve gas must have been involved, about 80% GB and 20% VX. No direct information has been published on the size or content of the German stockpile.

Destruction of obsolete or sub-quality nerve-gas munitions has been going on for at least a decade. Details of some of these operations are available in the open literature:

(a) More than 2,200 M–34 GB cluster-bombs had been demilitarized at RMA prior to 1969. (*11*) This number would have contained about 190 tonnes of GB.

(b) During 1967–68, a total of 51,180 M–55 nerve gas rockets were dumped at sea out of the New Jersey coast. (*11*) This would have involved about 250 tonnes of agent (presumably GB, although there could have been some VX).

[4] I have reviewed some of the reports of these allegations elsewhere: see Volume I of the SIPRI CBW study, *The Rise of CB Weapons* (1971), at pp. 203–205.

(c) From 1964 onwards, an undisclosed quantity of GB and VX ammunition, surplus to the requirements of an Arctic test programme, were destroyed at Fort Greely, Alaska. (*12*)

(d) In August 1970, about 60 tonnes of nerve gas, contained in 12,540 M-55 GB rockets, one M-23 VX landmine, and three 155 mm GB artillery shells, were dumped at sea out of the North Carolina coast. (*13*)

(e) Demilitarization of 21,115 M-34 GB cluster-bombs is currently under way at RMA, with completion scheduled for December 1974. (*14*)[5] Special equipment has been developed to extract the 1,900 tonnes of GB involved, which is then chemically destroyed with caustic soda. (*15*) (*16*)

All in all, therefore, at least 2,400 tonnes of nerve gas, most of it GB, has been or is being consumed in disposal operations.

This has recently become a figure of some significance, for at the end of 1973 written Congressional testimony submitted by the Organisation of the Joint Chiefs of Staff (OJCS) contained the following passage: (*17*)

> . . . during the period 1968 . . . to 1973 . . . the United States nerve agent stockpile was reduced 17.5% (this includes the M-34 clusters located at Rocky Mountain previously approved for destruction but does not include the stocks at Rocky Mountain Arsenal whose destruction was approved by the National Security Council on 3 October 1973).

It is not entirely clear whether the 17.5% figure refers to an actual physical reduction of stocks by demilitarization, as appears at first sight, or whether it is merely an accountancy figure reflecting a paper decision to reclassify part of the nerve-gas stockpile out of the War Reserve category pending future demilitarization. If the former is in fact the case, as seems more probable, the 17.5% figure must relate to the stocks that have been disposed of during the past six years plus the M34 stocks noted in (e) above; a total of about 2,400 tonnes, or rather more than 5m lbs. (Note that a figure much in excess of 2,400 tonnes would imply either that the OJSC got its dates wrong, or that the Department of Defense has been misleading the various Congressional committees which, during 1969 and 1970, held hearings on nerve-gas disposal, or that DoD has been contravening environmental-protection legislation.) This would mean that, prior to 1968, the US nerve-gas stockpile amounted to about 30m lbs, rather less than 13,000 tonnes.

This figure seems rather low; it could be, then, that the OJCS testimony was referring to nerve gas stockpiled in the United States, and excluded the OCONUS stockpiles in the Pacific and in Europe. This would mean—on the assumption (a) that total production of GB and VX was indeed about 50m lbs, and (b) that about 6m lbs of nerve gas have been and are being consumed in testing and demilitarization—that the OCONUS stocks amount to about 14m lbs. This would suggest that there might be some 5,000 tonnes of US nerve gas stored in Europe.

It is important to be able to form an idea of the proportion of the nerve-gas stockpile which is filled into munitions, or which is stored in bulk containers. The published data on the matter are, however, somewhat confusing, as will be seen.

In 1969, the Chairman of the JCS, General Wheeler, told a Senate committee that about half of the US chemical-agent stockpile consisted of mustard gas and the other half nerve gas. (*20*) (The mustard gas has since been declared obsolete, and is being burned.) (*14*) He also said that "the immediately usable portion of the stockpile, which is the portion which is in the filled munitions, comes to about 50% of the total supply". These figures were repeated by lesser luminaries of the DoD at other stages of the Congressional scrutiny of the FY 1970 defence budget. They carry the implication that the tonnage of nerve gas contained in filled munitions was about the same as the tonnage of unfilled mustard gas; and that the tonnage of unfilled nerve gas was about the same as the tonnage of mustard gas contained in filled munitions.

It is reported in the official US Army history of the Chemical Warfare Service that during World War II total mustard production was about 80,000 tonnes. (*23*) Although a few hundred tons were made before the war, there is no public record of any having been made after the war; and it seems improbable that there was any postwar production. The bulk of the wartime production was of Levinstein mustard (H), a rather unstable material that deposits sulphur sufficiently rapidly for munitions charged with it to become subquality within a few years; and it is known that very substantial quantities of mustard gas were disposed of in the post-war years. Thus, the filled munitions on hand when General Wheeler made his statement would almost certainly have contained the purified form of mustard gas known as "distilled mustard" (HD). Wartime production of HD

[5] There has been a good deal of slippage in the schedule since this estimated completion date was announced. The latest estimates are for December 1976. (*18*) Operations did not begin until 29 October 1973, and were temporarily halted 10 days later by an explosion in the works. (*19*)

amounted to 4,100 tonnes, (*23*) and the indications are that, just as there was no postwar mustard production, neither was there any postwar mustard distillation. This suggests that there could at most have been only 4,100 tonnes of mustard gas contained in filled munitions at the time of General Wheeler's statement. Actually the figure appears to be lower still, namely about 4m pounds, for in the aborted 1969 CHASE plans, 2,340 tons of HD (as opposed to H) in 1-ton bulk containers were scheduled for dumping. (*24*)

It might therefore be supposed from General Wheeler's statement that the bulk stocks of nerve gas at that time amounted to about 4m pounds. This estimate appears valid only if is assumed that all of the VX production has been filled into munitions, and that all of the bulk GB stocks are located at RMA. This is because DoD disclosed in November 1973 that the bulk stocks of GB at RMA amounted to 1,860 tonnes. (*8*)[6]

RMA contains only GB nerve gas, no VX, and there are at least eight other chemical-weapons storage sites in the USA. Of these, the principal nerve-gas site is at Tooele Army Depot in Utah (the others are said to contain mostly mustard gas, phosgene, &c., or unfilled chemical munitions).

With regard to this depot, a certain amount of rather contradictory information about its nerve-gas content came to light during the summer of 1973 when DoD was planning to transport all of the War Reserve GB at RMA to Tooele. (*2*) The shipment would have involved all of what was subsequently disclosed (*8*) to consist of the 1,860 tonnes of bulk GB referred to above, 147 tonnes of GB in *Weteye* bombs (ca. 900 bombs) 23 tonnes of GB in *Honest John* warheads (ca. 100 warheads) and 13 tonnes of GB in M139 bomblets (ca. 7,000 bomblets), i.e., a total of about 2,043 tonnes of GB. The planned operation was opposed by several Members of Congress, one of whom (Rep. Wayne Owens) subsequently stated that there was already about ten times that quantity of GB in storage at Tooele, together with large amounts of VX. (*9*)[7]

No distinction was made in this particular disclosure between filled and unfilled (if any) nerve-gas stocks at Tooele. However, according to a press-report by a visiting journalist, (*10*) there are at Tooele, in addition to filled nerve-gas munitions (such as VX spray tanks), "eight solid rows [of 1-ton bulk nerve-gas containers] stretching an estimated half mile or more". These bulk containers are 2.5 feet in diameter, so the reporter could have seen 8,000 or more of them. On this evidence, then, there might be as much as 6,000 tonnes of bulk nerve gas at Tooele. It is, however, known that there are several thousand 1-ton containers of mustard gas at Tooele, (*11*) and it could have been these—entirely or in part—which the reporter was describing.

Thus, assuming that there is no significant stockage of bulk nerve-gas anywhere else than at RMA and Tooele, the US stockpile of nerve gas in bulk storage could lie somewhere between 4m and 17m pounds.[8] When the War Reserve stocks at RMA are destroyed, the range will drop to 0–13m pounds.

Literature Citations

(*1*) Hylton, A. R. *The history of chemical warfare plants and facilities in the United States.* Midwest Research Institute, 13 November 1972. (Volume IV of the final report on contract ACDA/ST–197 with the US Arms Control & Disarmament Agency.)

(*2*) US House of Representatives, Committee on Armed Services. Subcom-

[6] These are the stocks, together with 183 tonnes of GB in filled munitions, whose destruction was approved by the NSC on 3 October 1973, and which were specifically excluded from the OJCS statement quoted above. (*8*) Part of this 455,000-gallon GB stockage is in 1-ton bulk containers (each holding about 170 gallons, 0.68 tonnes) and part is in large underground storage tanks. There are ten such tanks at RMA, each with a capacity of 10,000 gallons. (*22*)

[7] The implication here that there were, at that time, well over 22,000 tonnes of GB in CONUS stockpiles is at variance with the estimate, derived above from the OJCS statement, of a total CONUS nerve-gas stockage, GB and VX, of about 13,000 tonnes. Moreover, in a press report (*10*) purporting to quote what Rep. Owens had been told by an Army official, the factor of ten is made to refer, on the one hand, to the sum of the 2,043 tonnes War Reserve plus the 1,900 tonnes contained in the M34 cluster-bombs at RMA, and, on the other hand, to the total stocks of nerve gas at Tooele, VX as well as GB. This would suggest a CONUS nerve-gas stockage exceeding 43,000 tonnes. This seems improbably high, and would contradict both the OJCS statement and the estimate of total nerve gas production derived earlier in this Appendix.

[8] From these figures it seems that, if the other estimates in this paper are correct (namely that total production of nerve gas amounted to about 50m pounds, and that about 6m pounds of this have since been consumed in testing and demilitarization), between 60% and 90% of the available nerve-gas stockpile (including the condemned War Reserve stocks at RMA) is in filled munitions. It may be noted that an unpublished estimate (derived, apparently, from official sources) being quoted early in 1973 was that about 80% of the nerve-gas stockpile was in filled munitions.

mittee No. 1. *Hearings on H.R. 9745 etc.* H.A.S.C. No. 93–28. Washington DC (1973).

(*3*) Tonetti, S. 'Chemical Corps Phosphate Development Works'. *Armed Forces Chemical Journal* 10(5) : 32–34, 1956.

(*4*) 'Phosphorus oxychloride review asked of Army'. *Oil, Paint & Drug Reporter*, 12 July 1954.

(*5*) *Department of Defense appropriations for 1970.* Hearings before a sub-committee of the House Committee on Appropriations. Part 6, p. 116.

(*6*) *Congressional Record*, 8 August 1969, p. S.9495.

(*7*) *Japan Times*, 10 September 1971.

(*8*) *Supra*, ref. 2, p. 136.

(*9*) *Supra*, ref. 2, p. 7.

(*10*) Halliday, R. S. 'Lethal liquid lurks in Utah plot above ground and in safety', *Salt Lake City Tribune*, 5 August 1973.

(*11*) Report of an Ad Hoc Advisory Committee of the National Academy of Sciences. *Disposal hazards of certain chemical warfare agents and munitions.* June 1969.

(*12*) *Washington Post*, 7 January 1971.

(*13*) *Ocean disposal of unservicable chemical munitions.* Hearings (August 1970) before a sub-committee of the House Committee on Merchant Marine and Fisheries. Serial No. 91–31. *And* press reports on and around 17 August 1970.

(*14*) *Fiscal Year 1973 Authorization for Military Procurement etc.* Hearings before the Senate Armed Services Committee, part 2, page 606 (DoD written testimony.)

(*15*) *Disposal of M34 GB clusters and mustard gas at Rocky Mountain Arsenal, Colorado*, US Army Material Command news release REL No. 14–PI, 13 February 1970.

(*16*) *Supra*, ref. 2, pp. 126–140.

(*17*) *Supra*, ref. 2, p. 110.

(*18*) *Supra*, ref. 2, p. 135.

(*19*) *Denver Post*, 7 January 1974, p. 3.

(*20*) *Department of Defense appropriations for Fiscal Year 1970.* Hearings before a sub-committee of the Senate Committee on Appropriations. Part 1, p. 186.

(*21*) *Hearings on Military Posture . . . Fiscal Year 1970 etc.* before the House Committee on Armed Services. Page 3921.

(*22*) *Department of Defense Appropriations for 1970.* Hearings before a sub-committee of the House Committee on Appropriations. Part 5, p. 591.

(*23*) Brophy, L. P. *et al.*, *The Chemical Warfare Service: From Laboratory to Field.* Washington, D.C. : 1959, page 64.

(*24*) Report of the Department of the Interior Working Group on Possible Effects of Disposal of Chemical Warfare Munitions in the Sea. Washington, D.C., July 1969.

Appendix 2.—United States Nerve-Gas Weapons

This appendix comprises tabulated data on US nerve-gas munitions, experimental and standarized, which have been referred to in the open literature. The table is set out as follows :

I. Munitions charged with agent GB
- Tube and rocket artillery
- Infantry and other ground weapons
- Naval ordnance
- Guided missiles
- Aircraft spray-tanks
- Other aircraft ordnance

II. Munitions charged with agent VX
- (Same breakdown as in I)

III. Bomblet submunitions charged with G or V agent.

The last section also includes, for reference purposes, data on bomblets charged with agents other than the nerve gases. These include a number of biological-warfare bomblets, stocks of which have now been destroyed in accordance with President Nixon's BW policy-statements of November 1969 and February 1970. Details of other US CBW munitions are to be found in *CB Weapons Today* (Volume II of SIPRI's CBW study) at pages 82–89; the present appendix serves to identify rather more closely the documentary sources I used in that part of the SIPRI study, and to extend the information given there.

(Literature citations appear at the end of the appendix.)

DATA ON U.S. NERVE-GAS WEAPONS

Munition and designation [a]	Agent payload: Kilograms	Agent payload: Weight percent	Age [b]	Remarks
I. Munitions charged with agent GB (sarin, isopropyl methylphosphonofluoridate)				
Tube and rocket artillery:				
105-mm howitzer cartridge, M360.	0.74(3)	4.6(3)	A	
**4.5-in rocket, T164, for 24-tube launcher M21.	1.50(4)	8.3(4)		Being field tested in 1954 (4).
115-mm rocket, M55, for 45-tube launcher, M91.	4.88(3)	20(3)	B	$31.5 m procurement authorized 1960 (7). Unit cost ca. $120 each (8).
155-mm howitzer projectile, M121A1.	2.72(3)	6.0(3)	B	Unmodified version, M121, operational in mid-1950's.
155-mm field-gun projectile, M122.	2.95(3)	6.6(3)	A	
**175-mm field-gun projectile, T223.	6.68(1)	10(1)		In 1962, estimated operational by 1966 (1).
8-in howitzer projectile, M426.	6.58(3)	7.3(3)	B	
Warhead, M206, for 318 mm rocket, Little John.	30.7(3)	26(3)	B	52 M139 bomblets (10) Little John now obsolete.
Warhead, M79, for 762 mm rocket, Honest John.	177(1)	24(1)	A/B	For the early version of Honest John; 356 M134 bomblets.
Warhead, M190, for 762 mm rocket, Honest John.	210(3)	37(3)	B	368 M139 bomblets (10) Honest John is being phased out.
Infantry and other ground weapons:				
**3.5-in rocket, shaped-charge follow-through.				GB fill for M28A2 bazooka anti-tank rocket under study in 1966 (11).
**Floating aerosol generator				GB fill for AN-M7 floating smoke-pot under study in 1960 (12).
Naval Ordinance:				
5-in./38 naval-gun shell, Mk53 ModO.	1.45(1)	5.8(1)	A/B	
5-in./54 naval-gun shell, Mk54 ModO.	1.91(1)	6.6(1)	A/B	
5-in rocket, Mk40 ModO, for 48-tube launcher.	21.8(1)	9.5(1)	A/B	
6-in./47 naval-gun shell				Estimated 60 percent developed in 1957 (13).
Guided missiles:				
Warhead, M212, for Sergeant missile.	195(2)(3)	?21(1)	C	Ca.330 M139 bomblets (10) ?E21 formerly.
Warhead, M213, for Sergeant missile.				E9 formerly; uses M139 bomblets (14).
**Warhead, E27, for Lance missile (15).				Cancelled in 1970 with $7.2m spent since 1962 (16). Lance is replacing Little John, Honest John and Sergeant.
Aircraft spray-tanks:				
Spray-tank, 740-gal	ca. 145(17)		A(17)	
Spray-tank, 80-gal, Aero-14B	325(18)	52(18)	C	U.S. Marine Corps weapon (2).
Spray-tank, 100-gal, (19) ?TMU-16 (20).	ca. 400(20)	ca.67(20)	B/C	U.S. Air Force weapon. Requirement now rescinded?
Other aircraft ordnance:				
**2.75-in air-to-ground rocket				
Bomb, 500-lb, Mk94 ModO	49.9(1)	22(1)	A	Explosive type (1) unlike the Weteye splash bomb (21).
Bomb, 500-lb, Mk116 ModO (Weteye).	159(21)	ca.70	C	$4.4m procurement in fiscal year 1967 to replace Mk94 (22).
Bomb, 750-lb, MC-1	99.9(3)	30(3)	A	Modified demolition bomb (24).
Cluster-bomb, 1,000-lb, M34 (M34A1).	89.9(26)	18(26)	A	76 M125 bomblets (26). Unit cost about $1,200 (18) so about $30m on procurement in mid-1950s (RMA stocks). Now obsolete.
**Cluster-bomb, Misteye II				In 1966 estimated operational by 1968. (2). There is a U.S. Navy G-bomblet which has a 1.4 kg payload. (27)
Bomblet dispenser munition, CBU-15/A.	69.0(2)		C	40-tube SUU-13 with BLU-19/B23 bomblets (heavier than M139s (28) (2).
II. Munitions Charged With Agent VX (ethyl S-2-diisopropylaminoethyl methylphosphonothiolate)				

See footnotes at end of table.

DATA ON U.S. NERVE-GAS WEAPONS—Continued

Munition and designation [a]	Agent payload: Kilograms	Agent payload: Weight percent	Age [b]	Remarks
Tube and rocket artillery:				
115-mm rocket, M55, for 45-tube launcher, M91.	4.63(*3*)	18(*3*)	B	
155-mm howitzer projectile, M121.	2.95(*1*)	6.4(*1*)	B	
**155-mm howitzer base-ejection projectile.	?5.6(*27*)	?12(*27*)		9 155-mm canisters charged 3-lb VX on 1969 test schedule (*27*).
**155-mm DIACBA projectile(*46*).				Development stopped in late 1960's (*29*): DIACBA's [c] fall within art. 23(a) of the 1907 Hague Regulations prohibiting use of poisoned projectiles.
**175-mm field-gun projectile, T223.	6.04(*1*)	9.0(*1*)		In 1962 estimated operational by 1966(*1*).
8-in howitzer projectile, M426	6.40(*1*)	7.1(*1*)	B	
**Warhead for 762-mm rocket Honest John.	210(*1*)	37(*1*)		Refs (*1*)(*30*) are to a VX fill for the E19R2 whd (?M190 later).
Infantry and other ground weapons: Land mine, 2-gal, ABC-M23.	4.77(*3*)	46(*3*)	B	For issue at rate of 1 per 5 HE antitank mines(*10*).
Naval ordnance:				
**5-in/38 naval-gun shell, Mk-53 ModO.				Availability with VX fill implied in 1966 Army field manual(*31*).
**5-in/54 naval-gun shell, Mk-54 ModO.				Availability with VX fill implied in 1966 Army field manual(*31*).
Guided missiles: **Warhead for Sergeant missile.	190(*1*)	26(*1*)		Ref(*1*) is to a VX fill for the E21 whd (?M212 later).
Aircraft spray-tanks:				
**Spray-tank, E29R1				High-altitude VX-simulant spray trials conducted in 1962(*32*).
Spray-tank, 80-gal, Aero-14B	325(*18*)	52(*18*)	C	Adaptable also to wet BW-agent fill (tularemia agent UL1, etc.) (*18*).
Spray-tank, 160-gal(*35*) TMU-28/B(*2*).	ca. 650		C	For in-board stations of F-105 (*36*). Adaptable to herbicide fill(*37*).
Spray-tank, 1,000-gal(*19*) ?TMU-16(*20*).	ca. 400(*20*)	ca. 67(*20*)	C	16 t/d VX for this weapon in European-war contingency plans(*20*).
Other aircraft ordnance:				
**Bomb, 500-lb, Mk94 ModO				The ref (*38*) to VX fill for this weapon is unofficial.
**Bomb, 500-lb, Mk116 ModO (Weteye).				Availability with VX fill implied in 1966 Army Field Manual(*31*).
**Cluster-bomb, Misteye				Ditto. There is a U.S. Navy V-agent bomblet which has a 0.45 kg payload (*27*).
III. Bomblet submunitions charged with G or V agent				
[Open references exist to several nerve-gas bomblets other than those referred to above. They are presumably intended either for missile or rocket warheads, or for aircraft cluster-bombs or dispenser munitions. Cylindrical, spherical and cubical designs have been studied. (*39*)]				
The following nerve-gas bomblets have been identified in the open literature by U.S. Army designations:				
E54 bomblet, 10 lb				Under study for G-agents in 1952 (*40*). For clustering in E101 adapter (*41*). Perhaps became the M125.
E112 bomblet				Used in an experimental GB warhead for Corporal field-tested in 1957 (*42*).
E118 bomblet, spherical				An explosive-type bomblet field-tested with GB fill in 1958 (*43*).

DATA ON U.S. NERVE-GAS WEAPONS—Continued

Munition and designation [a]	Agent payload: Kilograms	Agent payload: Weight percent	Age [b]	Remarks
E130 bomblet, spherical, 4.5-in				By 1962, E130R2 had been field-tested in 44 warheads for Corporal, Little John, improved Honest John and Sergeant (*45*) 356 per quadrant-type warhead for improved Honest John (*47*) (*48*) 50 for Little John (*49*). Refs are to GB or GB-simulant fills (*48–49*). E130R2 looks like the M139 but appears to have a nipple and an extra pair of vanes per hemisphere (*21*) (*50*).
E133 bomblet, spherical, 4.5-in				Static tested with liquid fills on USAF proving ground in 1958 (*51*).
E139 bomblet, spherical				Said to be similar in shape and weight to M139 (*28*). At least 82, with GA, GB or GD fills, on 1969 open-air test schedules. (*27*).
M125 bomb, cylindrical, 10-lb				For the M34 GB cluster-bomb (*26*).
M134 bomblet				For the M79 warhead.
M139 bomblet, spherical, 4.5 inch (*53*).				For the M190, M206, M212, and M213 GB warheads (picture (*21*)).
BLU-19/B23 bomblet (USAF designation).				For the CBU-15/A GB dispenser munition (*52*). Larger and heavier than M139(*28*).
Bomblets charged with CBW agents other than nerve-gas include the following:				
E61 BW bomblet				Under development in 1957 for the E133 BW cluster-bomb (*54*) (*55*).
E120 BW bomblet				In development phase throughout 1957–60 (*50*) (*56–58*) 1944 per XMC-1 dispenser munition. Wet tularemia agent (UL1) fill, etc. (*18*).
E134 BW bomblet, spherical, 3.4-in.				Under development in 1962 (*59*) (*60*). Plastic; UL1, etc. fill; for Sergeant (740 per E23 warhead) and dispenser munitions (4,608 per XMC-1) (*18*).
M114 BW bomblet				For M33 BW cluster-bomb; brucellosis agent (AB) fill etc. (*61*) (*62*).
M138 CW bomblet, 10-lb				BZ thermogenerator munition for CBU-5/B (M43) cluster (*2*) (*5*).
M143 BW bomblet, spherical				For Sergeant; wet-agent fills (*18*). Same size as E139 and M139 bomblets (*28*).
BLU-20/B23 CW bomblet				BZ bomblet for CBU-16/A dispenser munition (*63*) (*64*). Similar to BLU-19/B23 GB bomblet (*28*).
BLU-21/B45 BW bomblet				Dry tularemia agent (ZZ) fill (*65*). For dispenser munitions.
BLU-22/B45 BW bomblet				Wet tularemia agent (TT) fill (*65*). For SUU 13/A-40-tube dispenser (*66*).
BLU-39/B23 CW bomblet				CS fill for CBU-19/A dispenser munition (*67*).

(a) Asterisked entries (**) in secs. I and II refer to munitions for which there is no open reference to approval for the operational inventory. They may therefore have been abandoned during development; or, like the undoubtedly sizable number of omissions from the table, they may still be on the secret list.

(b) *A* refers to the period up to 1958, denoting munitions which entered the operational inventory and/or were approved for operational use during this period. These are the 1st-generation GB weapons, some of which have now become obsolete. Large stocks of GB began to become available from the factory at Rocky Mountain Arsenal towards the end of 1954 (see appendix 1). *B* refers to the period 1958–62, denoting 1st-generation VX weapons and newly established GB-weapon requirements. Large stocks of VX began to become available from the factory (Newport Chemical Plant) during the middle of this period (see appendix 1). *C* refers to the period 1962–67, during which 2d-generation GB and VX weapons began to appear, especially ones for high-performance tactical aircraft.

(c) DIACBA's are multiple-fléchette munitions containing glass capsules of VX or XR toxin agent. Set-back forces rupture the capsules whereupon the spin of the munitions spreads the agent over the needle-like fléchettes (*29*).

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Appendix 3—Preparative Routes to Nerve Gas, and the Binary Concept

These notes, which are taken from a larger paper,[1] serve to illustrate some of the chemical processes which might be exploited in binary munitions. Their purpose is to identify the more obvious chemicals which should be of concern in the design of disarmament-verification procedures that can accommodate binaries. Since the notes are based solely on the open literature, there may well be other possibilities of equal or greater significance which have been omitted. An attempt has been made to expand the scope by including speculations on reactions which, although not described in the open literature, are nonetheless conceivable.

Literature citations are intentionally left incomplete.

Only two classes of nerve gas are considered:

(1) the G agents, excluding the tabun family: the alkyl alkylphosphonofluoridates;

(2) the V agents: the alkyl S-2-dialkylaminoethyl alkylphosphonothiolates.

Within these two classes, the compounds of particular relevance are those in which the P-alkyl group is a methyl or an ethyl group: toxicity tends to decline with increasing size of the group (although there are rather few published studies on this point). It is conceivable, perhaps, that appropriately-substituted P-aryl groups might also provide relevant compounds.

Not considered are those other classes of organophosphorus anticholinesterase agent which, although less toxic, have in the past been regarded as potential CW agents. The verification studies done by the Midwest Research Institute for the US Arms Control and Disarmament Agency, for example, have paid attention also to:

(a) the tabun family: the alkyl NN-dialkylphosphoramidocyanidates;

(b) the thiosarin family: the alkyl alkylphosphonothionofluoridates;

(c) the azidate analogues of (b): the alkyl alkylphosphonothionoazidates;

(d) and the armin family: the dialkyl, or alkyl aryl, alkylphosphonates.

And to this list might be added:

(e) the amiton family: the dialkyl S-2-dialkylaminoethyl phosphorothiolates;

(f) the Gd-7 family: the alkyl S-2-alkylthioethyl alkylphosphonothiolates;

(g) the dyflos family: the dialkyl phosphorofluoridates; and

(h) the selenium analogues of several of the foregoing families.

It is also to be noted that use of the binary mode would improve the candidacy as CW agents of a number of other super-toxic compounds previously rejected on the grounds of storage instability. Organophosphorus compounds within this category (and there may well be others which are not organophosphorus compounds) include the Tammelin esters, such as 3-dimethylaminopropyl methylphosphonofluoridate.

Whatever the agent, the binary mode imposes the following constraints on the choice of reactants:

(a) the binary components, when mixed, must react rapidly and spontaneously, preferably without a heat source and preferably without solvents, to generate toxic agent;

(b) the incidence of side-reactions, and other such factors limiting the yield of toxic agent, must be slight;

(c) if the binary reaction is one in which a second product, as well as toxic agent, is formed, that product must be of low molecular weight; and

(d) the binary components, both of which should preferably be liquid at ambient temperatures, must be stable on storage, and of low hazardousness; they should also be manufacturable in conventional industrial chemical plant.

G Agents, Excluding the Tabun Family: RO.RP(O)F

In proceeding from elemental phosphorus to a G agent such as sarin or soman, four successive chemical transformations have to be effected, namely alkylation, oxidation, esterification and fluorination. In principle, the terminal stage in the process could consist of any one of these four, so that there are four different

[1] *The Manufacture of CW Agents: Mustard and Nerve Gases* (June 1970, revised August 1973): the unpublished Appendix 4 to *CB Weapons Today*, volume II of SIPRI's *The Problem of Chemical and Biological Warfare*.

categories of precursor/reactant combination to be considered as potential binary-munitions fillings. Moreover, it may also be possible to conduct more than one of the transformations simultaneously during the terminal stage.

Alkylation as the terminal transformation can probably be ruled out as far as binary munitions are concerned: thermodynamic considerations militate against the alkylation of P(V) phosphorus, although such reactions can be performed under laboratory conditions.[2]

Oxidation as the terminal step is conceivable, but unlikely to be practical, if only because of the hazards associated with the handling of the precursor. Alkyl alkylphosphonofluoridites are barely described in the open literature.

A route to sarin in which the final step is a combined oxidation-alkylation has been described—patented, even (Childs & Williams, 1959)—but it does not appear to be adaptable to binary munitions.

Fluorination is a conceivable binary reaction, although not an obviously attractive one. The reactant in the binary combination would be a fluorine-donor, and the precursor a compound of general formula R'O.RP(O)X, where R and R' are alkyl groups determined by the type of nerve gas that is sought, and X is a nucleophilic leaving group. Laboratory preparations of G agents by this route have been reported as follows:

Precursor	Reactant	Conditions
(a) ^{i}PrO.MeP(O)NMe$_2$	HF	CCl_4, room temp. Greenhalgh & Blanchfield 1966.,
(b) ^{i}PrO.MeP(O)Cl	NaF	CH_2, Cl_2, 4 hr reflux Bryant et al. 1960.
(c) ^{i}PrO.MeP(O)SM	picryl fluoride	acetone, room temp. Boter et al, 1966; Boter & Van den Berg, 1966.
(d) EtO.MeP(O)SEt	2,4-DNFB, t.amine	heat, Bebbington & Ley, 1966.
(e) EtO.EtP(O)SEt	NaF/Ag+	water, room temp. Saville, 1961.

The precursors in (a) and (c) are solids, and those in (d) and (e) would yield a rather large quantity of (smelly) byproduct. The reactants in (c) and (d) would likewise yield a product containing only a low proportion of toxic agent. The precursor in (b) seems to be a potential binary component, although its storage stability is poor; if it were used, the other component would presumably be hydrogen fluoride, although this is not an easy substance to handle safely. There would, in addition, be the fact of hydrogen chloride as byproduct.

Esterification seems generally to be the most attractive possibility for a G-binary reaction. It has been used in several reported laboratory and plant-scale processes (Collomp, 1949; Bocquet, 1956; Zeffert et al, 1960; Bryant et al, 1960; Monard & Quinchon, 1961; Schmutzler, 1964*b*). The requisite alcohols are accessible, stable, and compatible with many of the bases or Lewis acids that could usefully serve as reaction-accelerants. Of the three conceivable types of precursor, F.MeP(O)Cl gives much the fastest rate of reaction in the case of GB formation with isopropanol; next comes the equimolar mixture ("didi") of MeP(O)Cl_2 and MeP(O)F_2; and slowest is MeP(O)F_2 on its own (Zeffert et al, 1960). Although the difluoride is the least reactive, it has the advantage of generating a byproduct (HF) which has a lower molecular weight than the HCl generated by the other two; and reaction-accelerators are available. Methylphosphonyl difluoride is the precursor used in the US G-binaries.

Fluorination and esterfication could conceivable be conducted simultaneously in a binary munition. The obvious precursor would be the dichloride RP(O)Cl_2, with a solution of hydrogen fluoride in the appropriate alcohol as the reactant. This has been used in laboratory and plant-scale processes for G-agents (Kharasch et al, 1945; Collomp, 1949; Bocquet, 1956; Zeffert et al, 1960; Reesor et al, 1960; Schmutzler, 1964*b*). However, since the rate determining step is the formation of the didi mixture referred to above, the only merit of this route is the greater accessibility of the precursor.

[2] Although no such reactions are reported in which the end product is a potential CW agent. Examples include the conversion of phosphorus pentachloride into methylphosphonous dichloride (Smirnov *et al*, 1967, 1968); of thiophosphoryl chloride into ethylphosphonothioic dichloride (Maier, 1962) or into methylphosphonothioic dichloride (Maier, 1967); of phosphorus pentafluoride into tetrafluoromethylphosphorane (Treichel & Goodrich, 1965); and of phosphoryl chloride into ethylphosphonic dichloride (Maier, 1962) or into mthylphosphonic dichloride (Olson *et al*, 1952; Jean, 1956).

V Agents: $R'O.RP(O)SCH_2CH_2NR_2$

V agent production differs from G agent production in that a second esterification, in which the basic-nitrogen side-chain is introduced, takes the place of the fluorination. In addition, a sulphur atom, which can be introduced during the oxidation or during one of the esterifications, may have to be manipulated into the right place: This would necessitate a fifth transformation, namely isomerisation. Moreover, the basic-nitrogen side-chain can be introduced in two stages, the second being an amination. The theoretical routes to V agents are thus more numerous than those to G agents, making the identification of potential binary components a more complex task. This task is not facilitated by the fact that much of the V-agent preparative work that has been done remains classified.

Alkylation as a terminal step suitable for a V-binary munition can be ruled out for the same reasons as with G agents.

An esterification reaction in which the unsubstituted alkoxy group is introduced is not reported in the open literature as a terminal step in V-agent synthesis. If it could be made to work, the precursor would presumably be a thiolochloridate, $R_2NCH_2CH_2S.RP(O)Cl$, such as might be obtained by the reaction of the appropriately aminated sulphenyl chloride with alkylphosphous dichloride and sulphur dioxide (Petrov et al, 1961*d*); but such a precursor seems unlikely to be particularly stable.

Esterification reactions in which the basic-nitrogen side-chain is introduced as the terminal step are commonly employed in laboratory V-agent preparations. The sulphur atom may be in the reactant or in the precursor, and in the latter case a simultaneous isomerisation may also be necessary. The relevant literature is as follows:

Precursor	Reactant	
$EtO.MeP(S)Cl$	$NaOCH_2CH_2NEt_2$	Schegk et al, 1961.[1]
$M[MeP(O)(S)OPr^i]$	$ClCH_2CH_2NEt_2$	Boter & Platenburg, 1967; Boter, 1969.[2]
$EtO.RP(O)Cl$	$HSCH_2CH_2NR_2$ plus	R-Et: Ghosh, 1958.
	Et_3N or Na_2CO_3	R-Me: Tammelin, 1957.
$^iPrO.MeP(O)Cl$	$NaSCH_2CH_2NEt_2$	Schegk et al, 1961.

[1] Compare Ghosh (1955), Calderbank & Ghosh (1960) and Schrader (1963a) on amiton; Fukuto & Stafford (1957), Tammelin (1957b) and Malinovskii et al (1960) on thiono-amiton (or homologues); and Kabachnik et al (1958) on Gd-6.
[2] Compare Ghosh (1955) and Calderbank & Ghosh (1960) on amiton; and Volkova et al (1961) on Gd-7.

All of these processes require a substantial heat input, however, and therefore seem unsuited to binary munitions.

Since amination as the terminal step might well be exothermic, it is possible to conceive of a compound such as $EtO \cdot MeP(O)SCH_2SCH_2Br$, or even its thionoisomer, as a binary precursor, the reactant being the appropriate secondary amine. This is suggested by a route to a Gd-7 homologue used by Volkova and coworkers (1961), and to thiono-amiton by Calderbank & Ghosh (1960).

The remaining group of theoretical possibilities, those in which oxidation constitutes the terminal step, seem to provide the most amenable binary components, even though the precursors would not be easy materials to handle safely. Phosphonites, like other trivalent phosphorus compounds, are powerful nucleophiles, and their attack on sulphur can be strongly exothermic. The resultant oxidation from the P(III) to P(V) state is capable of driving other reactions simultaneously. Thus it is possible to conceive of a V-binary reaction which combines oxidation with one of the other unit processes needed to attain the V agent. The other unit process may either be isomerisation or the second esterification. (An uncombined oxidation reaction is excluded from binary candidacy for the same reasons as with G agents: if a precursor could be found, it would be an even more hazardous material to handle than a straight nerve gas.)

The ovidation/isomerisation possibility is the one employed in the current US V-binaries, in both the liquid-liquid and the solid-liquid versions. The latter is based on the Newport manufacturing process for VX (Ferguson et al, 1972; Hylton, 1972), the precursor being $^iPr_2NCH_2CH_2O \cdot MeP \cdot OEt$ (otherwise known as QL), with powdered sulphur as the reactant. This reaction is not described in detail in the open literature, but full descriptions are available for the analogous processes resulting in systox (Ford-Moore & Wood, 1960) and Gd-7 (Hoffmann & Moore, 1958). Trivalent phosphorus is capable of extracting sulphur

from a variety of organic sulphur compounds.[3] This occurs most readily from the centre of a polysulphide chain, and somewhat less readily from episulphides; the compound known as NM (the reactant in the US liquid-liquid VX binary) is presumably one or other of these.

The oxidation/esterification possibility is not described in the open literature for V-agent production, although it is described for amiton (Ghosh, 1956; Calderbank & Ghosh, 1960), systox (Petrov et al, 1961*a*), and various diesters of methyl-, ethyl- and phenylphosphonotiolic acids (Morrison, 1956; Michalski & Wieczorkowski, 1959; Petrov et al, 1961*a* and 1961*c*). Possible precursors for this route include mono- and di-esters of the appropriate alkylphosphonous acids. The reactants would be compounds in which the appropriate 2-dialkylaminoethyl group is attached, via a sulphur atom, to a good leaving group (e.g., –Cl, –CN, –SR or –NR_2); 2-dialkylaminoethylsulphenyl chlorides would seem, at first sight, to be particularly suitable reactants for, for example, diethyl methylphosphonite.

Tabulated Summary

The two preceding sections suggest that, as far as G and V agents are concerned, potential binary component pairs include those listed in the following table. Those in group (a) are listed with more confidence than those in group (b), the latter relating to reactions or compounds on which the open literature gives little guidance. Chemists more knowledgeable and skilled that I could no doubt suggest amendments or additions.

Precursor	Reactant	Product	Byproduct
GROUP (A)			
$RP(O)F_2$	R'OH/accelerator	G	HF.
$F.RP(O)Cl$	R'OH	G	HCl.
$RP(O)F_2$ } equimolar $RP(O)Cl_2$	HF/R'OH	G	HCl.
$RP(O)Cl^2$	HF/R'OH	G	HCl.
$R'O.RP.OCH_2CH_2NR_2$	S	V	
Do	An episulphide or an alkyl polysulphide.	V	Alkene or alkyl disulphide, &c.
GROUP (B)			
$R'O.RP(O)Cl$	HF	G	HCl.
$R''_2NCH_2CH_2S.RP(O)Cl$	R'OH	V	HCl.
$R'O.RP(O)SCH_2CH_2Br$	R''_2NH	V	HBr.
$RP(OR')_2$	$R''_2NCH_2CH_2SCl$	V	R'Cl.

Note: R represents an alkyl group, most probably a methyl or ethyl group. R' and R" also represent alkyl groups, but ones which would be ethyl or larger; they could be cycloalkyl groups. The group NR $''_2$ could constitute a nitrogen heterocycle. Although the basic-nitrogen side-chain in the V-binary components is shown as an amionethyl group, it could contain more carbon atoms.

Chemical Glossary

Amiton (VG, Gd-80).—$(EtO)_2P(O)SCH_2CH_2NEt_2$
Armin.—$EtO \cdot EtP(O)OC_6H_4NO_2$ (*para*)
Dyflos (DEP·PF-3).—$(^iPrO)_2P(O)F$
Gd-6.—$EtO \cdot MeP(S)OCH_2CH_2SEt$
Gd-7.—$EtO \cdot MeP(O)SCH_2CH_2SEt$
Sarin (GB).—$^iPrO \cdot MeP(O)F$
Soman (GD)—$Me_3C \cdot CH(Me)O \cdot MeP(O)F$
Systox.—$(EtO)_2P(O)SCH_2CH_2SEt$. This compound is more properly referred to as "Demeton-S"; it is its mixture with its thiono-isomer, Demeton-O, that is generally known as "Systox".
Tabun (GA).—$EtO \cdot Me_2NP(O)CN$
Thiono-amiton.—$(EtO)_2P(S)OCH_2CH_2NEt_2$
Thiosarin.—$^iPrO \cdot MeP(S)F$
VX.—$EtO \cdot MeP(O)SCH_2CH_2NPr_2^i$

[3] For a review, see Kirby & Warren (1967), pp. 95–103.

CBW and National Security—November 3, 1969

This is a study of the strategic and tactical implications of chemical and biological weapons. While an analysis of this length cannot be exhaustive, the sponsors of this study group paper believe that it contains perspectives and recommendations worthy of consideration by this Congress and the Administration.

The sponsors of this study group paper are Congressmen: John Dellenback, of Oregon; Charles A. Mosher, of Ohio; Howard W. Robison, of New York; and Fred Schwengel of Iowa.

Additionally, the following Members of Congress have joined this study group in encouraging, through the release of this paper, a re-examination of the strategic and tactical purposes served by chemical and biological weapons.

Marvin L. Esch of Michigan
Peter H. B. Frelinghuysen of New Jersey
Gilbert Gude of Maryland
Frank Horton of New York
Paul McCloskey of California
Joseph M. McDade of Pennsylvania
F. Bradford Morse of Massachusetts
Ogden R. Reid of New York
Philip E. Ruppe of Michigan
Herman T. Schneebeli of Pennsylvania
Robert T. Stafford of Vermont
Charles W. Whalen, Jr. of Ohio

INTRODUCTION

The recent concern about safety procedures in the handling of chemical and biological weapons has caused us to re-examine the purposes for which we have these weapons. Our effort has necessarily involved analysis of the advantages and disadvantages of CBW in each of the situations our country faces or might face. Accordingly, we have considered chemicals and biologics as deterrents to all-out war and as tactical weapons in limited wars. It stands to reason that the judgment of the Congress concerning the future of these weapons must be based on this kind of analysis.

We need to determine whether these weapons are valuable additions to our already impressive arsenal of conventional and nuclear weapons. It is not justifiable to continue developing, producing and testing chemical and biological weapons simply because we can develop safe testing and storage procedures for them. Also, we cannot logically accept the rationale that we need chemical and biological weapons simply because some other country is engaged in CBW production. Similarly, it is not enough to say that they enhance "flexibility": one must analyze their specific advantages. Only weapons which add a positive measure to our overall national security deserve support.

As a result of our inquiry, we question whether chemical and biological weapons add significantly to our security. The risks we run by using and maintaining secret stockpiles seem to outweigh the dubious advantages offered by these weapons.

On this page and the next page, we will present a few of our concerns, highlighting rationales which are elaborated in the main body of the paper. Here we will also offer some recommendations.

As deterrents to all-out war, chemical weapons are neither more cost-effective nor certain than our nuclear deterrent. Biological weapons are doubly uncertain as mass killers. On the one hand, their effectiveness can be blunted by extreme weather conditions or unpredictable biological reactions. On the other hand, a successful attack by us could initiate an epidemic that might spread to infect our own population. When a weapon is potentially dangerous to both the attacker and the attacked, retaliatory threats lack sufficient credibility.

Although many have accepted the notion that CB weaponry is humane, we are dubious. Many of these weapons are naturally inhumane, while others which

could theoretically be used to reduce war deaths have actually been used to increase them. Contrary to the assumption that weapons which have been secretly developed and tested for years will perform effectively in the field, many of them have not significantly improved our military position and many more cause severe ecological damage which may make them less acceptable than conventional weapons.

We suspect that virtually all CBW is highly escalatory in limited war. When we fight limited conflicts to avoid all-out war, chemical and biological weapons may push us toward total war. When we are willing to escalate, chemicals and biologics are very likely at least as escalatory as tactical nuclear devices.

Finally, we find that in the field of CBW there appear to be unique opportunities to disarm voluntarily or on a negotiated basis. There is genuine international interest in reaching a negotiated settlement on CBW, yet it is doubtful that the elimination of our chemical and biological stockpiles would result in significant military loss.

We are cognizant of the dangers associated either with using these weapons or secretly continuing to produce and stockpile them. There are already indications that our use of chemicals causes serious and permanent damage. Yet, even this damage is small when compared to the unpredictable misery that a full-scale biological attack might initiate or the total war that a chemical attack might provoke during a limited conflict. By possessing these weapons we increase the likelihood of use. In addition, we risk an international incident when an unexplained epidemic provokes charges of a secret biological attack. Finally, these uncertain weapons have a destabilizing effect on relations between adversaries because they make rational calculations difficult.

Because the logic of this paper suggests that the disadvantages of CBW outweigh their marginal advantages and because it takes into account both the evils and the alleged benefits of CB weaponry,

We recommend careful consideration of the following actions:

(1) Eliminating all stockpiles of chemical and biological weapons, including any low-level chemicals designed for military use. This does not include riot control agents used for crowd control in the U.S.

(2) Publicizing the results of future research in the field of CBW.

(3) Encouraging international agreement on the prohibition of chemical and biological production and usage.

(4) Ratification by the U.S. of the 1925 Geneva Protocol.

(5) Declaring that the United States will not use such weapons but will respond to their use by adversaries with appropriate conventional or nuclear force.

I. THE WEAPONS

The term "Chemical and Biological Warfare" is a misleading one. It is not a form of warfare but rather a conglomeration of weapons which must be incorporated into the military strategies and doctrines which have already been developed to maintain our defense posture. The sweep of the phrase masks the diversity of our silent arsenal.

The purpose of this study is to outline the role that chemical and biological agents could play in our overall defense strategy. Where possible, we have attempted to evaluate the merits of the systems as an alternative to those weapons already in use. We also consider briefly the possibility of a negotiated agreement on the production of chemical and biological agents.

It is important that chemical and biological agents be constantly regarded as alternative weapon systems. If objective evaluation indicates that they do not prove better than present armaments, there can be no justification for adding them to our arsenal. Different criteria are unsatisfactory. Maintaining the primacy of flexibility is an imprecise position. If two weapons are of unequal value, certainly only the better one should be deployed. If they are equal, joint deployment is unnecessarily wasteful.

Arguing that the U.S. must develop a weapon because an adversary is doing so is not logically adequate; it is a rationalization of advocates. Keeping up with the Joneses in weapons development is useful only when our own security requires that enemy systems be duplicated. This reasoning was relevant during the recent ABM debate. We did not need an ABM because the Soviets had one. We needed it only if our deterrent force would be vulnerable without it. Likewise, American stockpiles of CBW are not justifiable merely because of Soviet initiatives.

A. The Differences Between Chemicals and Biologics

There are several different categories of possible chemical and biological weapons. Toxins, which are produced by biological organism but cannot themselves reproduce, have been classed with chemical agents in this study as they were in the UN Report on CBW. (See appendix.) While there are significant differences between categories, the basic characteristics of chemical agents are different enough from those of biological weapons that general distinctions between the two classes are both possible and helpful. Biological agents are living organisms which reproduce, chemical weapons are not. It is this basic difference which accounts for the major variations between them.

1. Extent of Effects

Because they are alive, biological agents can pose a danger for a long time and affect a wide area as they reproduce. Chemical agents are effective for only a relatively short time and the area they affect is determined solely by the size of the initial attack and the weather conditions in the strike zone. Thus, when an attack must be controlled geographically, chemical agents are preferable to their biological counterparts. Yet when a general attack is called for, biological weapons are more relevant.

2. Speed

Speed is often absolutely necessary in a military engagement. With the exception of defoliants which require several days to achieve maximum results, chemical weapons can act immediately or within a few hours. In comparison, biological agents are extremely slow. The quickest take at least a day to act and some have incubation periods of three weeks.

3. Duration

The two systems also differ markedly in their duration of effect. The living organisms of a biological weapon may lie dormant for years or centuries before finally infecting humans. Decontamination of infectious areas is difficult at best and impractical for large areas. Chemicals may evaporate relatively soon after an attack, but under certain environmental conditions or after repeated use, areas may remain contaminated for months.

4. Intensity

Some chemical agents are short-term incapacitants, but the most dangerous are those which are designed to kill quickly. Even those previously characterized as temporary have been found to have lingering side-effects such as permanent damage to the eyes or lungs. Conversely, although biological weapons are usually considered lethal, some organisms have been developed which cause illness for a while but make eventual recovery possible.

B. Military Characteristics

To be useful additions to our military arsenal, these weapons should meet a number of criteria. They should be easily delivered, cheaply produced, difficult to defend against, effective under all weather conditions and reasonably controllable. Chemical and biological agents measure up to some of these standards but fall short of others.

1. Delivery

Chemical agents can be delivered in almost any form. They can be dispersed in aerosol sprays, hand grenades or small rockets. In addition, aerial spraying as well as bomb and missile attacks can be used. These systems can also deliver biological weapons, although short-range delivery vehicles are dangerous since the disease could easily return to the attacking troops. A unique delivery method for biological weapons is sabotage. A fifth-column movement is virtually undetectable; and a small amount of infectious biological organisms could quickly spread in the atmosphere or through a water supply to infect population centers. Yet for a large-scale attack the most probable delivery method would be an aerial spraying from a missile or airplane.

2. Production

Both chemicals and biologics can be cheaply and quickly produced in massive quantities with available laboratory and industrial equipment.

3. Defensibility

Defenses against the agents can be directed against the delivery systems or the agents themselves. Luck seems to be an essential part of the defense against sabotage attempts, but defense already developed against bombers and missiles should be equally effective whether CBW or nuclear warfare is being attempted.

Some chemical and biological agents are susceptible to medical treatment. But this treatment must be swift and certain. Because of the necessity for speed, the agent might be incorrectly identified. The wrong antidote for a chemical attack could kill the intended victim; a disease will continue unchecked if the wrong biological antibiotic is prescribed.

Of course, protective measures are possible only after an attack is detected. Nerve gas is odorless, colorless and tasteless. Unless troops correctly identified an incoming rocket as a chemical one before impact, one-third of them could die before they had a chance to don gas masks. Thousands of citizens could be fatally infected by a saboteur's biological attack before officials learned of the deadly contamination. Thus, defense against surprise attacks is extremely difficult and should be largely discounted when setting policy.

4. Weather dependence

An unfortunate change in weather conditions can greatly reduce the effectiveness of both types of weapons when they are dispersed in aerosols or impact explosion devices. Because of this tenuous dependence on the weather, they are not reliable military aids.

5. Controllability

On the other hand, even when weather conditions are favorable an effective attack cannot be easily controlled. In some cases the area affected is indeterminable. In others, the intended victims are not only victims. There is a constant danger that lingering effects will wreak havoc in the area for years after the war ends.

When chemical weapons affect a region they may affect all men and animals in the area. Herbicides can be confined in a specific area. But while they are aimed only at plant life, they may also directly affect the local human and animal populations.

Most biological agents infect only one species, but the infection can spread endlessly, affecting areas far from the initial attack which may not be involved in the war.

Perhaps the most frightening dimension of these weapons is their long-term effects. Even seemingly harmless defoliants now being employed in tactical situations can affect the overall ecological balance of the area and promote extinction of those species which depend on the foliage for nourishment. Plant diseases may make critical inroads into the food supplies of already starving nations. Biological agents could linger in an area and rekindle an epidemic long after treaties were signed and enmity had ceased. They could renew the pangs of war when only historians remember why the war began.

C. Military Missions

Because of the distinctions between the two types of weapons, their military missions are quite different. Chemical agents are considered tactical weapons, to be used in limited engagements. They act quickly and remain in a relatively limited area under favorable weather conditions. They can therefore be incorporated into larger battle plans.

Lethal biological weapons are reserved for all-out conflicts. Once they infect a population, an epidemic of unforeseeable proportions is possible. No battlefield operation calls for such devastation.

II. THE STRATEGY

Knowledge of the military characteristics of these weapons makes possible an examination of their implications for national security.

Our national security depends both on an ability to deter attack and on a capacity of defend against one should deterrence fail. Defense strategy is a purely military science; whereas our deterrence strategy determines our diplomatic posture and public image throughout the world. While the two con-

cepts are related, they are not the same. Many policy discussions suffer because they assume that whatever is good for defense is of equal benefit to deterrence. This is not necessarily so. Weapons which make military victory more probable may also make victory necessary by making war more likely.

National policy makers have relied upon two basic theories of deterrence and defense: counterforce and finite deterrence.

A. Counterforce

Counterforce strategy, as the term suggests, is directed at the military force of the enemy. It hopes to disarm the enemy quickly by destroying his weapons. If it is successful the enemy will be forced to quietly surrender, accept a stalemate or face extinction. The strategy focuses on military targets, not population centers.

CBW does not contribute to our counterforce posture. In an all-out war, these weapons cannot stop incoming missiles or blunt their destructiveness. They cannot ground planes or destroy missiles in their silos. Their primary function would be to attack population centers.

Even if it were assumed that we could become involved in a war which prized strikes against munitions factories during a protracted test of industrial strength, CBW would not be significantly better than conventional tactics. Biological attacks would be difficult to pinpoint and the general population could be afflicted. Chemical agents might be controlled, but they would kill people while leaving the enemy's industrial capacity intact. In both cases, new workers could resume production and repeated strikes would be necessary. Conventional sorties which destroyed the factories themselves would be far preferable in such an unlikely war situation.

B. Finite Deterrence

The strategy of finite deterrence focuses on population attacks and is more suitable for CBW. This strategy attempts to prevent war by making victory so costly or so unlikely that attack is an enemy's least acceptable option. The main focus is on all-out war. We attempt to discourage aggression by threatening retaliation against population centers which would make victory too costly. Presumably any opponent perceives a level of damage which would be unacceptable when set against the gains expected from victory. Since this damage threshold is measurable and thus finite, the retaliation we threaten is finite. Accordingly our posture is termed one of finite deterrence. Once this damage threshold is reached, there is no reason to exceed it. The enemy will be deterred when the minimum threshold damage is assured. Threats of more damage will not produce more deterrence.

An essential element in this strategy is flexibility. The level of damage threatened must be correlated with the attacker's stance. Too little will not deter. Too much in a limited conflict will be disproportionate and thus either irresponsible or unbelievable.

When completely articulated, the theory attempts to respond to aggression at whatever level it is offered with a two-fold purpose in mind. First, enemy victory must be forestalled. Second, conflicts must be decided at the lowest possible level of violence. Consequently, there are three major facets to finite deterrence strategy: minimum deterrence, which makes all-out war politically and morally unacceptable; limited war, which seeks to counter all other forms of force or blackmail; and arms control, which attempts to keep tensions low by keeping force levels low and balanced between adversaries.

Minimum deterrence seeks to maintain an invulnerable strike force capable of inflicting unacceptable losses on the enemy by attacking his population. Of course this threat is only credible if it is used to deter a minor land probe since it would immediately escalate a local conflict into a world-wide conflagration.

The technique of limited war was incorporated to react to localized threats which do not warrant total war. If our limited war capabilities are great, we should be able to deter attacks in any form by threatening an appropriate level of violence.

To deter attacks and keep the attacks that cannot be deterred as small as possible, arms control is a major goal of any strategy of finite deterrence. Arms control also aids deterrence by reducing international tensions which increase the chances of war. While complete disarmament is not feasible, at least for

the present, some arms control is a reasonable and highly desirable goal. Another section of this paper will consider the importance of including CBW in such controls.

1. Minimum Deterrence

a. Civil defense possibilities

Since minimum deterrence threatens to strike a terrible blow to the civilian population of an enemy, civil defense measures might reduce casualties and defeat the purpose of the deterrence measures. However, as a practical matter, civil defense cannot be relied upon to nullify the threat of CBW. Detection of a covert attack is difficult if not impossible. The measures required to protect a population even if an attack is anticipated or identified are highly impractical. Pressurized shelters with air filters would be required to prevent exposure to a continued buildup of harmful agents. In addition, sophisticated laboratory equipment and biological experts would be needed in every shelter to identify and treat diseases before a general epidemic struck underground. Thus, civil defense should not give a victim solace or an attacker pause. The success of a CBW attack will not be significantly diminished by civil defense measures taken against it.

Civil defense against nuclear attacks aimed at population centers cannot avoid millions of deaths in the immediate blast area, even though some civilians might survive deadly fallout if adequate shelters were available. Thus, nuclear weapons will remain a credible deterrent despite attempts to develop civil defense systems.

Because all three weapons can elude or overwhelm civil defense systems, population vulnerability is high regardless of which type of attack is considered. Yet, aside from civil defense considerations, there are significant differences in the application of deterrence strategy to chemical, biological and nuclear weapons.

b. CBW as a deterrent

Lethal chemical weapons such as nerve gas would probably require more delivery vehicles than nuclear weapons to achieve the same unacceptable level of damage. Since their range is determined by the wind direction and velocity, several gas missiles would be necessary to inflict damage equal to that of a single nuclear warhead. If delivery costs were an important factor, nuclear strikes would be more attractive since fewer missiles would be necessary. If assured destruction were the aim, nuclear weapons would again be chosen, since wind and weather conditions could blunt a chemical strike but leave a nuclear blast unaffected.

Yet chemicals might still be retained as a deterrent force. They could be responsible for avoiding a purely chemical attack. A special case has been made for retaining a substantial lethal stockpile in Western Europe to deter a major conventional and chemical onslaught from the East. It is feared that if the U.S. were to abandon its chemical stockpiles, the East would seize upon a tempting opportunity to use lethal chemicals with great success.

Some fear that the West would be faced with an unfortunate triad of options if it did not retain chemicals. NATO might be forced to retreat while suffering heavy casualties from persistent gas attacks. It might equip its troops with protective clothing while ceding a mobility advantage to the East which could be decisive. Finally, it might respond with tactical nuclear weapons to exact a casualty toll from the East similar to the losses its own forces suffered from gas attacks.

It is argued that a substantial arsenal of lethal chemicals could avoid this difficulty, since gas responses to gas attacks would force the East to don protective clothing and make mobility difficult for both sides for the duration of the war. The East might be successfully deterred from using gas if it realized that the West was prepared to respond in kind and neutralize its short-lived tactical advantage.

Yet this scenario is not necessarily a convincing case for a lethal chemical arsenal. It obviously does not weigh the risks of possession which we outline below. In addition, a large-scale conventional war in central Europe may not be possible. Escalation to tactical nuclear weapons or expansion of the war to homelands may be virtually automatic. Certainly it is difficult to imagine a war in Europe which began with lethal chemicals on one or both sides and did not quickly escalate to other weapons and other battlefields.

Yet the most important distinction which must be made in reviewing this scenario is one between deterrence and defense. While some may flinch at the thought of actually using tactical nuclear weapons when another course is open, it is not clear that the threat of nuclear retaliation would not be effective in deterring chemical warfare in Europe. If tactical nuclear devices can deter a chemical attack, the issue of actual retaliation becomes moot.

Finally, actual defense with chemical weapons may not be significantly better than with nuclear devices. There are no meaningful civil defense measures against either weapon. Both sides would have to assume that tactical nuclear weapons might be used against them and disperse their forces accordingly. This would mean that even strikes at clearly identified military targets with either weapon would involve substantial civilian and military losses. Thus, the different intensity between lethal chemical attacks and low-level nuclear blasts might be small and the case for chemical responses to chemical attacks would be marginal.

Biological weapons have also been justified as a deterrent force. There again is no practical civil defense. The delivery systems are as invulnerable as nuclear vehicles, and it seems reasonable to assume that both superpowers will remain vulnerable to a full-scale missile attack for the foreseeable future. A fifth column of saboteurs should remain potent in spite of unforeseen advances in missile and bomber defenses. Nevertheless, biological attacks are not a successful deterrent threat.

Effective deterrence must result from a credible threat of assured destruction judged unacceptable by a potential aggressor. Yet it is reasonable to conclude biological warfare neither assures destruction nor allows for a credible threat.

Even after a biological strike began, the extent of the damage would be unknown. Aerosols would be the most likely delivery method for a large-scale biological attack. Yet reliance on them means that extreme weather conditions might kill the organisms before they had an opportunity to infect the population. Certainly it would be difficult for an attacked nation to wait patiently for perfect weather conditions for retaliation. Consequently, the possibility of a complete failure is a constant danger in biological warfare and the requisite of assured destruction is lacking.

The credibility of a biological threat is undermined by the frightening prospect of a successful attack—one which initiates an epidemic. The disease could be uncheckable. The plague would honor no natural or national boundaries. Once the infection was identified, a terrified population would scurry in all directions to avoid contamination. Yet they themselves would be the carriers who would transform a localized attack into an international tragedy.

Even laboratories with controlled environments and strict safety precautions have been unable to completely avoid infection by these lethal agents. Only strict quarantine procedures and a fair amount of luck have prevented several research accidents from becoming general epidemics.

Uncontrollable biological weapons could endanger their user; they might return to infect his population. The unbridled infection he had unleashed could return to destroy the attacker as well as the attacked. Even a country which was confident that it possessed a secret antibiotic could not launch such an attack. Living organisms often change their characteristics as the result of a mutation. Hardy mutant strains could continue to spread disease after the administration of antibiotics which would have neutralized the original disease strain but which proved ineffective against the new breed of killers.

Of course any threat to exterminate millions of people is incredible. But one is more incredulous when posed with a threat of biological destruction than when a nuclear threat is maintained. By developing "clean" bombs we have attempted to minimize the residual effects our own population might suffer if we retaliated. Consequently, population losses in the U.S. would have to result from a decision by the enemy to launch a second salvo of missiles targeted on our cities. There is a very real possibility that an enemy leader would pause under the stress of a nuclear exchange and accept defeat before issuing a death warrant for another score of megadeaths. Biological weapons do not afford this opportunity to avoid mass destruction in both the attacking and attacked nation; a single disease can spread over both populations without waiting for a second decision from an opposing leader. Thus, while a nuclear retaliation makes national suicide a possibility because a devastated foe might decide to slaughter his enemy, a biological attack makes self-destruction dependent both on the

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course of an uncontrollable epidemic, and upon the unpredictable decision of an adversary.

Thus it seems that our overall deterrence posture would not be significantly enhanced by the threat of a biological response. The brinksmanship inherent in modern day aggression would be buoyed by the hope that retaliation would be unsuccessful. In addition, the threat of a biological response loses its credibility as the likelihood of success increases. An effective attack carries with it the fearsome danger of a global epidemic which could sweep all before it, friend and foe alike. Accordingly, the threat of a biological response may be either the threat of no response or of retaliation so costly to both sides that it might not be believed and thus not heeded.

Nuclear weapons are significantly better than biological ones for deterrence purposes. They are just as fearsome and more certain and controllable. Sole reliance on nuclear threats should preserve a credible deterrent for the U.S. Adding a biological menace would not significantly improve that deterrent.

Successful biological attacks are at least as humanly destructive as nuclear strikes. Thus, there is no reason to prefer a biological response in hopes of avoiding all-out nuclear war. Both deal death in massive proportions.

c. The vicious response

Relying on biological weapons as a vicious military response to an all-out attack has little justification. A biological reaction to either a biological or nuclear strike might be extremely damaging and yet less effective than a nuclear response.

We indicated earlier that the incubation period for lethal organisms is from one day to three weeks. This incubation period begins only after a victim has contracted the disease. Thus, an attacker is busily destroying its enemy's wealth and population, the beleaguered victims must wait patiently for their deadly infection to fester. In the meantime, they must accept unmerciful punishment. All the while, the original attacker might feel that he could fight continuously against an enemy that was unable or unwilling to retaliate. Such a confident adversary could be expected to increase the intensity of his attacks as long as he felt he was doing so with impunity.

In contrast, a nuclear response would be quick, calculable and highly damaging. An attacker would be forced to reassess his position against a determined foe willing to fight rather than surrender.

2. Limited War

The term limited war implies that both the weapons used and the area engaged are limited. Such conflicts are entered when the objective is worth all-out war, but when it might be achieved at lower costs in a limited conflict. In other situations, limited wars are fought when the stakes are high enough to justify armed action, but too low to justify total war.

Certainly no country is willing to rattle its nuclear sabres during every international incident. Some areas are just not worth a nuclear war. Yet they may be valuable to a country—valuable enough for a limited war. Other areas may be worth a nuclear war, but victory might be achieved without one if a flexible conventional force were available. To avoid being muscle-bound in most international crisis situations, the nuclear powers have developed a capability and theoretical framework for waging limited war.

When a nation is willing to risk all-out war to achieve its goal, there are no holds barred in the limited phase of the war. Of course, if victory can be won without resorting to nuclear weapons, none will be used. But the enemy is kept constantly aware that its opponent is taunting it up the nuclear ladder. There must be no doubt about the attacker's ultimate resolve.

However, when the stakes are not high enough to justify all-out war, the opponent must be advised that the war will be kept limited. The attacker is willing to accept defeat rather than escalate to nuclear weapons in search of victory. If there is any doubt on the part of the opponent, there exists the danger

that he will escalate the conflict of his own accord in an attempt to show his resolve and perhaps win the war quickly.

Therefore, there must be implicit limits placed on such a war so that both sides clearly understand that they are fighting a truly limited conflict—not one that could reach the unlimited stage. Usually geographic and weapons limitations are self-imposed by both sides as evidence of their good faith. There are no logical reasons for these barriers, since there are no clear logical demarcations between limited and total wars. They are merely different levels of conflict in a continuous scale of violence. The value of the barriers lies in the assurance they provide to an opponent that he need not fear all-out attacks during this particular war. Once these restrictions are decided upon and recognized by both sides, it is clearly of prime importance that they not be abandoned by either side in quest of a small military advantage, lest all barriers fall and all-out war actually result.

There are three main reasons advanced for including chemical and biological weapons in our limited war arsenal. Advocates claim they are: first, more humane than other conventional weapons; second, effective in fulfilling military missions; and third, high intensity responses to enemy action which do not involve a significant danger of nuclear escalation.

a. Humane Weapons

Some proponents of chemical and biological warfare dream of "wars without death." They claim that military objectives can be achieved without the necessity of killing the enemy. They envision sleeping armies, soon to wake captives of a merciful opponent.

For some chemical and biological weapons, this argument is clearly irrelevant. Nerve gas and deadly plagues are no more humane than the conventional weapons they seek to replace or supplement. For other agents, previous military usage indicates that they have been used in conjunction with tactics which seek to kill the enemy.

Biological agents aimed at crops or animal life are used to deprive the enemy of his food supply. Yet any starvation tactics hit the army slowly—after the rest of the population has suffered from malnutrition while the army commands scarce food reserves. The policy of starvation is inhumane as conceived and unconscionable as practiced, since it first hurts those most in need of food and only eventually cuts the rations of the enemy forces.

Biological agents which affect man are also inhumane. Mild forms of disease are not militarily useful because they do not sufficiently guarantee an incapacitated enemy to insure peaceful victory. The lethal agents are just as deadly as conventional weapons and they invariably affect civilians. Certainly, weapons which deal not only death but indiscriminate death cannot be considered humane.

Chemical agents have been developed and used to defoliate large areas identified as enemy strongholds or to destroy crops. Those which seek starvation are indeed inhumane. Those which defoliate enemy hiding places do not result in humane treatment either. Fields of fire and bombing targets are revealed as leaves slowly wither. An enemy caught in these areas cannot expect merciful treatment. Instead, he can fear unobstructed shelling and bombing raids. His death is made more likely because chemical weapons were used by his enemy.

There are both lethal and non-lethal chemical weapons which are used directly against men. Lethal agents, primarily nerve gases, are certainly not humane. In fact, there is less possibility of being merely wounded by nerve gases than by conventional weapons. Even a small dose of these gases can be fatal. Thus, mortality rates are increased when nerve gases are used.

Riot-control gases and harassing agents are not designed to be fatal. If administered in laboratory-prescribed doses they do not kill or permanently damage their victims. But in battlefield conditions, too much gas is usually preferred to too little and there are strong probabilities of permanent damage or even death if an "overdose" strikes an enemy.

Chemical weapons which are theoretically capable of achieving victory without bloodshed have frequently been used to increase enemy casualties. Although the gases themselves are not fatal, they are often employed in tactical situations when the enemy is concealed from conventional weapons. Chemicals are then used to drive the enemy from his hiding place so that he can easily be fired upon.

The inhumane deployment of these weapons during battlefield situations may not be more inhumane than the use of comparable conventional weapons. However, chemical and biological weapons can continue to be inhumane long after the battle is ended. The area may remain contaminated for days, years, perhaps centuries. No conventional weapon is likely to cause this much prolonged suffering. Weapons aimed at plant or animal life may cause serious ecological imbalance, break natural food chains and disrupt environmental stability. Biological agents could cause damage of this magnitude in wide-ranging areas. It is conceivable that entire species, perhaps even man, would move toward extinction after a large attack.

Theoreticians have not realized their visions of wars without death. As now employed, chemical and biological weapons are usually used to kill the enemy directly or indirectly. At times their use kills scores of non-combatants.

b. Effective weapons

The most persuasive argument for military tacticians is that CBW is an effective weapons system. It does things better, quicker, cheaper or safer than alternative weapons. The crucial element in evaluating these claims is the definition of an effective weapon. Most chemical and biological agents can be successful in fulfilling a mission. But the additional damage they cause may make them ineffective weapons in an overall analysis, since an effective weapon should seek to maximize the chances of ultimate victory while minimizing the war's destructiveness.

There is no question that biological agents can be terribly efficient in destroying plant and animal life. Yet starvation may not be an effective addition to military tactics, since the armed forces would be the last to suffer from shortage. In some situations they might never suffer if they maintained supply lines with non-combatant allies.

But the more significant disadvantage to biological agents is their uncontrollability. The disease may return to destroy the attacker's food supplies. They may also spread to neighboring territories. Since military men, like most people, prefer to keep the number of enemies to a minimum, uncontrolled blight could be a severe setback. Neutral nations which helplessly witness their plant or animal life die might feel strong public pressure to avenge the attack as quickly as possible.

When human diseases are meted out to an enemy, the disadvantages are similar but more pronounced. Even a hypothetical army that could secretly innoculate its troops and stockpile a biological agent could not consider the agent an effective weapon. The disease could easily spread beyond the war zone and the pressures for retaliation by neutral nations would again be tremendous. The initial successes achieved by using the agents could be nullified when war was declared by the enraged nation accidently infected by the attacker. In addition, the attacking troops might be afflicted by the same disease when a mutant which proves immune to previous vaccines returns to plague them. Both of these possibilities make ultimate victory less likely. Either one makes a biological agent an ineffective military weapon.

The positive disadvantages of biological strikes must be considered in conjunction with their inherent unpredictability. As demonstrated previously, less than perfect weather conditions can quickly kill bacteria before they infect the enemy. A weapon which works only occasionally is probably worse than no weapon at all, since plans which assume effective results from its use may leave troops helpless if the weapon fails.

Chemical defoliants are effective in killing crops. The question is how effective crop attacks are in defeating an enemy. Defoliants which seek to clear the coun-

tryside of enemy camouflage are eventually successful in denuding the area. Yet there is a real question about the military consequences of these sprayings. It takes several days for the chemicals to take effect. After they have, there is usually renewed growth in the area within a week. During this short period of defoliation, the enemy can avoid barren areas and move only through jungle that has not been affected. Persistent use can prolong the defoliation effects and perhaps even kill trees in the vicinity. Yet a militarily effective program would have to blanket a wide area while continuing to concede relatively concealed movement at night. When the advantages of this program are weighed against the significant disadvantages resulting to the soil, foliage and wildlife of the region, the effectiveness of the weapons is doubtful. Victory is not significantly enhanced while damage to the war zone is certainly intensified.

Defoliants have also been used to deny roadside cover to enemy ambushers. But it should be realized that clear roadbeds often merely widen the fire zone, thereby increasing the exposure of one's own troops as they seek shelter from attack.

Chemical agents aimed at enemy troops have varying degrees of effectiveness. Harassing agents can be effective if the enemy is not equipped with masks. Usually these agents are used to force the enemy out of hiding into clear fields of fire or to prevent enemy pursuit or ambush when friendly troops are moving.

Lethal agents, particularly nerve gases, can be extremely efficient killers. Attempts have been made to develop warning and decontaminating devices to use in conjunction with masks as defenses against nerve gas. Yet present systems are costly, cumbersome and only partially effective. Observers estimate that troops fully equipped with protective devices would still suffer 30% casualties before they could react to a surprise attack.

c. High intensity, nonescalatory weapons

1. *Completely limited war.*—The final and most crucial argument advanced in favor of the use of chemical and biological weapons is that they allow a high intensity response which does not escalate the conflict. Where the U.S. is involved in a limited war and has decided it will not resort to all-out war for victory, this justification is of prime importance. If this argument fails, the other two rationales offered for their use become moot. The danger resulting from escalation far outweighs the benefits which allegedly humane or efficient weapons offer.

When limited war is initiated because all-out war is not justified by the stakes of the conflict, all reasonable precautions must be exercised to insure that the war will remain limited. As we indicated earlier, the normal way of telling an opponent that the war will not be escalated is establishing arbitrary geographical and military boundaries for the conflict. Chemical and biological weapons probably transgress both bounds.

Lethal biological weapons, if successful, can kill as effectively as nuclear warheads. Thus the artificial restraints on the level of violence which are established in a truly limited war would be greatly exceeded. The shift to nuclear war would be a small one. It would be made because nuclear weapons were more reliable, not because they were necessarily more destructive.

In addition, the arbitrary geographical limits set might be unintentionally violated by any biological weapon. Sanctuaries relied upon by one side and honored by the other could well be infected by the attacking biologics. Moreover, the agents could spread to neighboring countries. This is an extremely frightening prospect for conflicts on the Sino-Soviet periphery, such as those in Korea or Vietnam. An uncontrolled epidemic might quickly engage an otherwise uninvolved superpower in all-out war.

Lethal chemical weapons probably also pose an unacceptable risk of escalation by exceeding artificial restrictions on the type of weapon used, since successful nerve gas attacks might kill as many enemy troops as a nuclear blast.

Thus, both biological weapons and lethal chemicals could break delicate barriers which are relied upon to distinguish limited war from all-out war. But even

chemical agents which are not designed to kill the enemy may be dangerously escalatory and thus undesirable. This danger is a consequence of the psychological overtones associated with CBW. As we indicated at the beginning of this study, the term "chemical and biological warfare" masks a wide variety of weapons included in it. Since the entire category is normally eliminated from combat situations, with the exception of low level chemical agents which harrass or defoliate, using one of the more unusual forms of CBW immediately makes the use of all CBW weapons more likely.

The artificial psychological barrier between conventional and chemical-biological-nuclear warfare is an uncanny one. Reliance on it to distinguish limited from all-out war is wise. Breaking it in selected instances may mean breaking it altogether. Once gases and diseases are used on the battlefield, distinctions between types of gasses and diseases may seem academic.

The Vietnam experience has been deceptively fortunate. Escalation might well have occurred had the North possessed the weaponry or the Russians and Chinese the motivation to intensify the conflict. Initial world reactions to American tactics did not distinguish between types of gases. Distinctions were painstakingly clung to by the U.S., even though Hanoi lacked a chemical arsenal to force escalation with. If they had, the war might have lurched precipitously forward toward a full-scale holocaust when the first tear gas canister was introduced on the battlefield. The safest course is to observe the barriers without exception. For once the established barriers are broken, it may be too difficult or too late to erect new ones.

ii. *Initially limited conflicts.*—In those wars where the U.S. decides the stakes are high enough to warrant all-out war, weapons which are escalatory may have a place in our military plans. But inclusion of CBW in those plans depends upon how escalatory these weapons are when compared with others already in our arsenal. If they are at least equally likely to lead to all-out war, there seems to be no justification for using them when other weapons can produce similar military results.

A decision to run the risk of total war by first engaging in a limited war does not necessarily mean that we will follow a course inevitably culminating in total war. There would be little reason to alert the opposition if all-out war were certain to result from a local encounter. We will enter a limited conflict when the stakes justify total war only when there is a significant chance of deciding the issue without resorting to total war.

Put another way, we fight limited wars with an understanding that the objective is worth a risk of total war. That risk may be relatively high or relatively low. Once it is gauged, our strategy must be tailored accordingly. If we are willing to run a 70 percent chance of total war, then all military responses which make total war more than 70 percent likely are to be avoided. All weapons which do not make total war 70 percent likely can be used, even though they might be characterized as "escalatory." Given this theoretical framework, chemical and biological weapons could be justified in a limited war over high stakes if they were less escalatory than other systems with similar military capabilities.

It should be understood that the criteria for assigning an escalation coefficient to weapons is not their military effectiveness, but their psychological impact on the opposition. Because of the long tradition of abstinence from lethal chemicals, biological agents and nuclear devices in limited wars, all three weapons are likely to have a similar psychological impact on the enemy and therefore be equally escalatory.

Since we have been capable of fighting limited wars in the past without relying on anything more than conventional forces, a decision to use lethal chemical, biological or nuclear weaponry is an implicit admission that purely conventional strategy is incapable of achieving victory. It is a signal to the enemy that this realization was accepted and a recourse to new, escalatory weapons was chosen instead of surrender. The use of any of these weapons is a proc-

lamation that defeat will not be accepted without resorting to great military strength. With this warning, an enemy is just as likely to initiate an all-out war regardless of the particular weapon chosen to rupture the tradition of abstinence.

The possibility of escalation results from the breaking of tradition, not from the military mission these weapons are assigned. Their employment indicates that convenional warfare cannot do the job and defeat is unacceptable. Thus it is unlikely that lethal chemical or biological agents could be considered less escalatory than tactical nuclear weapons.

Consequently it seems that, in both the case of limited war which must stay limited and the case of limited war which runs the risk of total escalation, chemical and biological killers cannot be considered valuable for their non-escalatory characteristics.

3. Arms Control

To complete a strategy of finite deterrence, efforts must be constantly made to control the quantity and destructiveness of weapons. War is best deterred when neither side has sufficient hardware to fight one. It is best limited when the types of arms available are limited.

Lethal chemical and biological weapons impede both goals of arms control; thus there are two important reasons for seeking to control the development and proliferation of CBW.

According to publicized reports, both the U.S. and the Soviet Union have large stockpiles of these weapons. Arms control is therefore necessary to limit the quantity of arms available. The initial decision to stockpile has been made. Now the laborious process of disarming faces us.

We have indicated earlier that chemical and biological weapons are extremely destructive. The lethal agents kill large population masses when successfully employed. The non-lethal agents are also highly destructive and may lead to swift escalation when used.

The disarmament issues associated with chemical and biological weapons are in many ways unique. Since chemical and biological weapons have been developed as substitutes for other systems, disarmament can be pursued without significantly decreasing our security in the process.

a. Voluntary

Because it is doubtful that decreasing our CBW stockpiles would yield significant military danger, voluntary disarmament remains a possibility. It might significantly decrease international fears over the weapons even .if no other power followed our lead. But there are strong reasons to believe that others would quickly join in a sincere move toward eliminating lethal chemical and biological weapons from the international scene. To some extent we have justified our stockpiles on the grounds that the Soviets have similar arsenals. Certainly neither side can be comfortable when an uncertain balance of terror exists instead of a calculated equilibrium or deterrence.

The Soviets have repeatedly called for accords on CBW, as have Germany and one of the leaders in biological testing—Great Britain. Thus, both sides may be anxious to be rid of their systems if only the other side begins the process. If it is correct to assume that U.S. military security would not be impaired by the elimination of CBW stockpiles, a viable proposal might be that the U.S. take the initiative; if others then followed our lead, world stability could very well be enhanced.

Voluntary disarmamnt in the field of chemical and biological weapons has much to commend it. Military strength could be maintained and similar disarmament might begin in other countries. Regardless of the consequences in the rest of the world, the U.S. could claim unchallenged leadership in the quest for arms control and gain immeasurable world support in her efforts.

b. Negotiated

In a framework of negotiated arms reductions, chemical and biological weapons also offer distinct possibilities. If it assumed that both sides truly fear their actual use in conflict, as public sentiment in both camps indicates, then both sides would be eager to eliminate them from their adversary's arsenal. Because the weapons are not essential to the security of either party, then both can offer major concessions without fearing military insecurity as a result. Thus, suggesting accords on chemical and biological weapons at the beginning of arms talks could test the sincerity of the other parties in achieving significant arms limitations. It could also develop procedures which could be duplicated in other phases of the proposed agreement.

i. *Secrecy and inspection.*—One important area of disagreement which could be resolved in a CBW pact is the joint issue of secrecy and adversary inspection. Chemical agents could easily be developed from compounds used for many industrial purposes. Biological agents could be produced in a converted brewery, far from the view of an adversary denied treaty inspection rights. Secret research could also nullify the effect of the agreement by developing new agents not covered by previous talks. While this may not shift the military balance, it would demean the prestige of the treaty if both parties realized that circumvention was relatively simple. To avoid circumvention of the agreement, on-site inspection procedures and fluid scientific exchanges must be demanded.

Experts have developed inspection patterns which they feel can insure a sufficient probability of detection to make treaty violation attempts unattractive. But because of the general lack of interest in arms control agreements over CBW, there have been no serious efforts to advance these systems in a formal agreement. If inspection systems are agreed to for chemical and biological weapons, their incorporation into nuclear treaties should be much easier.

Eliminating the secrecy which has previously surrounded CBW research and deployment is both necessary for a successful arms limitation agreement and wise as a measure designed to eliminate irrational fears associated with CBW in general. Because no one is quite sure of the extent of our CBW arsenal, whispered tales of a "doomsday bug" cannot be dismissed out of hand. Fear is generated both at home and abroad because of what *might be* stored in secret garrisons, not what is actually stockpiled there.

A second proposal could be the initiation of arms talks to consider CBW. If such advances are spurned, we might then advocate eliminating our stockpiles with wide public knowledge. Also to be considered as possible steps should be the de-classification of future research in the field. We gain nothing by hiding information about a weapons system that seems to be untrustworthy; yet we risk much by encouraging our opponents to believe the worst about such a weapons system.

ii. *Nuclear accords.*—If nuclear agreements are seriously contemplated, as we hope they are, then CBW accords are essential. Otherwise the existence of devastating chemical and biological reserves would subvert any nuclear agreement by continuing an arms race with CBW even though the nuclear surge had been halted. An agreement on nuclear weapons should be a signal that mass death is being made less likely, not that different weapons have been chosen to annihilate humanity.

III. THE RISKS

Incorporation of chemical and biological agents into our overall military strategy, it seems, would involve more than an unnecessary waste of funds for a marginal addition to our military might. Continuing secret research with these agents and augmenting stockpiles of those weapons which have reached the production stage would probably involve enormous risks for our own security and future world stability.

A. Of Use

It is frightening to realize that the dangers of using CBW are perceived most not by the uninformed but by those most knowledgeable in the field. Prize-winning biologists imagine with horror the ultimate consequences of a large biological attack. Chemists who have worked toward weapons development realize that even non-lethal agents can become killers if the wrong dosage is involved.

Our evaluation of the military merits of the various weapons points repeatedly to the following possible disadvantages: Plotting starvation in a world which is already wrestling with the spiraling problems of population and hunger is short-sighted. Tampering with nature's delicate balance is imprudent when the dangers associated with a volatile environment are incalculable. Initiating worldwide epidemics is indeed "medicine in reverse" and adds a dimension of horror and primitivism to modern warfare which is understandably decried by many.

It is important to appreciate the international repercussions of using chemical weapons in Vietnam. By making them respectable after an almost complete international avoidance of them since World War I, the U.S. has made all chemical weapons more attractive in any future war. Once the barrier between conventional and chemical weapons is broken, it is difficult if not impossible to erect new ones which distinguish between categories of chemical weapons.

There are several reasons why chemical warfare would be attractive to many nations once international prohibitions against their use could be easily ignored. They are relatively easy to develop and comparatively inexpensive if a nation feels a need for a mass killer to improve its security. The U.S. has already made scores of countries aware of the potential advantages that chemicals offer by training foreign military officers in the use of these weapons.

The recent Nuclear Non-Proliferation Treaty has made these weapons even more attractive. Denied access to nuclear weapons, countries which still feel a need to exercise independent initiatives with strategic weapons turn quite naturally to CBW. While previous international accords may have deterred them from actually using such weapons, our policies in Vietnam have made CBW a little more respectable and may have made CBW proliferation a real danger.

As with nuclear weapons, the U.S. loses a measure of security when many smaller countries possess a capacity for CBW. Chemical and biological weapons are equalizers in battle which mute the advantage the U.S. maintains in industrial strength and conventional military firepower. It would certainly be better to forego the marginal benefits which CBW provides if such abstinence made proliferation less likely. If weak opponents can respond with CBW, we would not only lose the advantage we had sought by using such weapons, but we would also face the neutralization of our conventional firepower advantage.

B. Of Stockpiles

The dangers of actual use obviously become greater as our stockpiles mount. Moreover, previous experience indicates that an impressive arsenal makes battlefield use quite likely. A long abstinence from all chemical and biological weapons was foresaken in Vietnam after a previous decision to research and develop the weapons had been made. During the conflict, only the decision to employ the gas was necessary. There have been reports that biological weapons were not used during the Cuban missile crisis because they were not available. Other sources indicate that biological strikes have been proposed during the current conflict but pressures to use them were successfully resisted.

It is reasonable to assume that as our capacities in the field of CBW grow, opportunities for using them will seem more numerous. One assent would set a perilous precedent. Reliance on the abstinence of the past does not insure continued avoidance if the weapons are constantly available when military plans are formulated. It is likely that only elimination of the weapons can insure avoidance of them and their inherent dangers.

C. Of Secret Possession

Yet, even before they are actually incorporated into normal combat operations, we run significant risks by testing and producing chemical and biological weapons. Presumably, chemical and biological agents significantly increase international instability and tension because rational calculations are very difficult. As with any weapons system, possession indicates the possibility of use. Thus, although we constantly profess peaceful policies and argue that CBW research is defense-oriented and stockpiling is for deterrent purposes, our adversaries remain unconvinced. They are frightened by our arsenal. Their fears may well lead to unstable relations between our nation and others.

Because of the possibility of covert biological attacks, these fears can conceive a crisis from an accident. If any country were to suffer a sudden epidemic of an unusual or unknown disease it might immediately assume that a traditional enemy had attacked it with biological weapons. Assurances to the contrary might prove futile. A war might begin because of a freak fever or a laboratory mishap. Adequate control of biological weapons could very well reduce the likelihood of such a scenario.

If detection devices were developed and installed, they could increase tensions as well. A false alarm could create diplomatic chaos as accusing fingers were pointed at dozens of potential attackers before the true origins of the alarm were discovered. By maintaining a large, secret arsenal, the U.S. runs the great risk of being a prime suspect if a CBW attack were alleged for any reason. Denying such a charge would be extremely difficult and shifting the blame to another nation may be politically impossible.

Not only are enemy intentions difficult to calculate when chemical and biological agents must be considered, but the capabilities of the enemy are also uncertain. As a possible victim of such an attack, a nation must calculate its position under the assumption that the weapons will be highly effective. Yet as a possible attacker, each nation must play it safe by assuming that these agents will be largely ineffective. The latter set of assumptions will usually persuade a nation not to attack, but the former hypothesis may make a country overly fearful of attack. While one party is developing a peaceful line of diplomacy because it assumes it does not have the capability to use CBW, its opponent is constantly on guard against a CBW attack because it is possible and it must be assumed successful. Neither party benefits from this two-edged sword. Stable relations are subverted because of the unstable calculations which must accompany all adversary situations involving CBW.

It is these risks which must be weighed against the alleged benefits of CBW. Because such questions concerning the disadvantages of CBW exist, there is clear cause to consider the elimination of chemical and biological weapons from our present arsenal.

When considering the desirability of crop destruction or defoliation, the indeterminate damage that may be done to the balance of nature in pursuit of military gain should not be forgotten. The marginal safety which biological weapons add to our deterrent ought to be coupled with the misery which an uncheckable epidemic could promote. Although the suggestion that the weapons be abandoned might seem too extensive. The uneasy diplomatic and political situation which inevitably haunts the nation if it retains them might warrant such thought.

As with any priority decision, serious consideration ought to be given to the alternative resource demands which the nation constantly makes. The scientific talent devoted to perfecting virulent disease strains may be more urgently needed in the quest for medical breakthroughs. The funds required for testing and producing delivery systems might be better spent alleviating the many domestic problems now facing the country. A decision on military affairs must be made within the context of competing peacetime demands. Thus the balance between costs and benefits, advantages and disadvantages must be struck after

weighing both military and non-military factors. In the case of CBW, especially lethal varieties, the balance seems heavily weighted against the weapons.

IV. CONCLUSION

One of the possible results of eliminating our silent arsenal might be the avoidance of the dangers of escalation presently believed associated with CBW. If such a policy were adopted, the risks of stockpiling and the horrors associated with using these weapons could be avoided.

Consideration of applying the brakes in our headlong rush toward developing chemical and biological killers should be a matter of the greatest urgency. These weapons seem ill-suited to today's military strategies. At best, they might be characterized as unacceptable substitutes for weapons already in use. Their abandonment could provide a greater atmosphere of rationality in military calculations and a more secure state of mind for modern day man by removing one horrifying threat to his existence.

TABLE I.—GENERAL CHARACTERISTICS OF LETHAL CHEMICAL AGENTS

Type	Mechanism	Time for onset of effects	Examples
Nerve agent G	Interferes with transmission of nerve impulses.	Very rapid by inhalation (a few seconds)	Tabun, Sarin, Soman.
Nerve agent V	do	Very rapid by inhalation (a few seconds); relatively rapid through skin (a few minutes to a few hours).	VX.
Blister agent	Cell poison	Blistering delayed hours to days; eye effects more rapid.	Sulfur mustard; nitrogen mustard.
Choking agent	Damages lungs	Immediate to more than 3 hours	Phosgene.
Blood agent	Interferes with all respiration.	Rapid (a few seconds or minutes)	Hydrogen cyanide.
Toxin	Neuromuscular paralysis	Variable (hours or days)	Botulinum toxin.

Source: U.N. report.

ANNEX C.—SOME BIOLOGICAL AGENTS THAT MAY BE USED TO ATTACK MAN

Disease	Infectivity [1]	Transmissibility [2]	Incubation period [3]	Duration of illness [3]	Mortality [3]	Antibiotic therapy	Vaccination [4]
Viral:							
Chikungunya fever	Probably high	None	5 to 6 days	2 weeks—a few months.	Very low (<1 percent).	None	None.
Dengue fever	High	do	5 to 8 days	A few days to weeks.	Very low (<1 percent).	do	Do.
Eastern equine encephalitis	do	do	5 to 15 days	1 to 3 weeks	High (>60 percent)	do	Under development.
Tick-borne encephalitis	do	do	1 to 2 weeks	1 week to a few months.	Variable up to 30 percent.	do	Do.
Venezuelan equine encephalitis	do	do	2 to 5 days	3 to 10 days	Low (<1 percent)	do	Do.
Influenza	do	High	1 to 3 days	do	Usually low, except for complicated cases.	do	Available.
Yellow fever	do	None	3 to 6 days	1 to 2 weeks	High (up to 40 percent).	do	Do.
Smallpox	do	High	7 to 16 days	12 to 24 days	Variable but usually high (up to 30 percent).	do	Do.
Rickettsial:							
Q-fever	do	None or negligible	10 to 21 days (sometimes shorter).	1 to 3 weeks	Low (usually 1 percent).	Effective	Under development.
Psittacosis	do	Moderately high	4 to 15 days	1—several weeks	Moderately high	do	None.
Rocky Mountain spotted fever	do	None	3 to 10 days	2 weeks to several months.	Usually high (up to 80 percent).	do	Under development.
Epidemic typhus	do	do	6 to 15 days	A few weeks to months.	Variable but usually high (up to 70 percent).	do	Available.

Bacterial:							
Anthrax (pulmonary)	Moderately high	Negligible	1 to 5 days	3 to 5 days	Almost invariably fatal.	Effective if given very early.	Do.
Brucellosis	High	None	1 to 3 weeks	Several weeks to months.	Low (<5 percent)	Moderately effective	Under development.
Cholera	Low	High	1 to 5 days	1 to several weeks	Usually high (up to 80 percent).	do	Available.
Glanders	High	None	2 to 14 days	4 to 6 weeks	Almost invariably fatal.	Little effective	None.
Melioidosis	do	do	1 to 5 days	4 to 20 days	Almost 100 percent fatal.	Moderately effective	Do.
Plague (pneumonic)	do	High	2 to 5 days	1 to 2 days	do	Moderately effective if given early.	Available.
Tularemia	do	Negligible	1 to 10 days	2 to several weeks	Usually low sometimes high (up to 60 percent).	Effective	Do.
Typhoid fever	Moderately high	Moderately high	1 to 3 weeks	A few to several weeks.	Moderately high (up to 10 percent).	Moderately effective	Do.
Dysentery	High	High	1 to 3 days	A few days to weeks	Low to moderately high depending on strain.	Effective	None.
Fungal: Coccidioido mycosis	do	None	1 to 3 weeks	A few weeks to months.	Low	None	Do.

[1] Infectivity: Indicates the potency of the parasite to penetrate and multiply in the host's organisms, regardless of the clinical manifestation of illness. In fact, there are several agents by which the great majority of the exposed population will be infected without developing clinical symptoms.

[2] Transmissibility: This refers to direct transmission from man to man without the intervention of any arthropod vector.

[3] The figures listed under incubation period, duration of disease, and mortality are based on epidemiological data. They vary, according to variations in virulence and dose of the infecting agent, resistance of the host, and many other factors. It also should be noted that, if the agents concerned, would be deliberately spread in massive concentrations as agents of warfare, the incubation periods might be shorter and the resulting symptoms more serious. As to mortality, this refers to the ratio between the number of fatalities to the number of diseased (not to that of infected) individuals, if no treatment is given.

[4] The availability of vaccines is no indication of their degree of effectiveness.

Source: U.N. report.

Protocol Prohibiting the Use in War of Asphyxiating, Poisonous or Other Gases, and of Bacteriological Methods of Warfare, Geneva, June 17, 1925

The undersigned plenipotentiaries, in the name of their respective Governments:

Whereas the use in war of asphyxiating, poisonous or other gases, and of all analogous liquids, materials or devices, has been justly condemned by the general opinion of the civilized world; and

Whereas the prohibition of such use has been declared in Treaties to which the majority of Powers of the world are Parties; and

To the end that this prohibition shall be universally accepted as a part of International Law, binding alike the conscience and the practice of nations;

Declare:

That the High Contracting Parties, so far as they are not already Parties to Treaties prohibiting such use, accept this prohibition, agree to extend this prohibition to the use of bacteriological methods of warfare and agree to be bound as between themselves according to the terms of this declaration.

The High Contracting Parties will exert every effort to induce other States to accede to the present Protocol. Such accession will be notified to the Government of the French Republic, and by the latter to all signatory and acceding Powers, and will take effect on the date of the notification by the Government of the French Republic.

The present Protocol, of which the French and English texts are both authentic, shall be ratified as soon as possible. It shall bear to-day's date.

The ratifications of the present Protocol shall be addressed to the Government of the French Republic, which will at once notify the deposit of such ratification to each of the signatory and acceding Powers.

The instruments of ratification of and accession to the present Protocol will remain deposited in the archives of the Government of the French Republic.

The present Protocol will come into force for each signatory Power as from the date of deposit of its ratification, and, from that moment, each Power will be bound as regards other Powers which have already deposited their ratification.

In witness whereof the Plenipotentiaries have signed the present Protocol.

Done at Geneva in single copy, this seventeenth day of June, One Thousand Nine Hundred and Twenty-Five.

States Parties to the Protocol for the Prohibition of the Use in War of Asphyxiating, Poisonous or Other Gases and of Bacteriological Methods of Warfare, Done at Geneva June 17, 1925

States which have deposited instruments of ratification, accession, or continue to be bound as the result of succession agreements concluded by them or by reason of notifications given by them to the Secretary-General of the United Nations:

Argentina—May 12, 1969
Australia—Jan. 22, 1930 [1 a b]
Austria—May 9, 1928 [1 a b]
Bahamas [1 a b 2]
Barbados [1 a b 2]
Belguim—Dec. 4, 1928 [1 a b]
Botswana [1 a b 2]
Brazil—Aug. 28, 1970
Bulgaria—Mar. 7, 1934 [1 a b]
Burma [1 a b 2]
Canada—May 6, 1930 [1 a b]
Central African Republic—July 31, 1970
Chile—July 2, 1935 [1 a b]
China—Aug. 7, 1929
China, Dem. People's Rep.—Aug. 9, 1952 [1 a b]
Cuba—June 24, 1966
Cyprus—Dec. 12, 1966
Czechoslovakia—Aug. 16, 1938 [1 b]
Denmark—May 5, 1930
Dominican Republic—Dec. 8, 1970
Ecuador—Sept. 16, 1970
Egypt—Dec. 6, 1928
Estonia—Aug. 28, 1931 [1 a b]
Ethiopia—Sept. 18, 1935
Fiji—Mar. 21, 1973 [1 a b]
Finland—June 26, 1929
France—May 9, 1926 [1 a b 2]
Gambia, The—Nov. 16, 1966
Germany, Federal Republic—April 25, 1929
Ghana—May 3, 1967
Greece—May 30, 1931
Guyana [1 a b 2]
Holy See— Oct. 18, 1966
Hungary—Oct. 11, 1952
Iceland—Nov. 2, 1967
India—April 9, 1930 [1 a b]
Indonesia—January 26, 1971
Iran—July 4, 1929
Iraq—Sept. 8, 1931 [1 a b]
Ireland—Aug. 18, 1930
Israel—Feb. 20, 1969 [1 a b]
Italy—April 3, 1928
Ivory Coast—July 27, 1970
Jamaica—July 31, 1970
Japan—May 21, 1970
Kenya—July 6, 1970
Kuwait—Dec. 15, 1971 [1 d]
Lativa—June 3, 1931
Lebanon—April 17, 1969
Lesotho—Mar. 15, 1972
Liberia—April 2, 1927
Libya—Dec. 29, 1971 [1 b d]
Lithuania—June 15, 1933
Luxembourg—Sept. 1, 1936
Madagascar—Aug. 12, 1967
Malawi—Sept. 14, 1970
Malaysia—Dec. 10, 1970
Maldives—Jan. 6, 1967
Malta—Oct. 15, 1970
Mauritius—Jan. 8, 1971
Mexico—Mar. 15, 1932
Monaco—Jan. 6, 1967
Mongolia—Dec. 6, 1968 [1 b]
Morocco—Oct. 13, 1970
Nepal—May 9, 1969
Netherlands—Oct. 31, 1930 [1 c 4]
New Zealand—Jan. 22, 1930 [1 a b]
Niger—April 19, 1967
Nigeria—Oct. 15, 1968 [1 a b]
Norway—July 27, 1932
Pakistan—June 9, 1960
Panama—Dec. 4, 1970
Paraguay—Jan. 14, 1969
Philippines—May 29, 1973
Poland—Feb. 4, 1929
Portugal—July 1, 1930 [1 a b]
Romania—Aug. 23, 1929 [1 a b]
Rwanda—June 25, 1964
Saudi Arabia—Jan. 27, 1971
Sierra Leone—Mar. 20, 1967
Singapore [1 a b 2]
South Africa—Jan. 30, 1930 [1 a b]
Spain—Aug. 22, 1929 [1 a b]
Sri Lanka—Jan. 20, 1954
Swaziland [1 a b 2]
Sweden—April 25, 1930
Switzerland—July 12, 1932
Syrian Arab Republic—Dec. 17, 1968 [1 d]
Tanzania—April 22, 1963
Thailand—June 6, 1931
Togo—April 5, 1971
Tonga—July 28, 1971
Trinidad and Tobago—Nov. 30, 1970
Tunisia—July 12, 1967
Turkey—Oct. 5, 1929
Uganda—May 24, 1965

U.S.S.R.—April 5, 1928 [1 a b]
United Kingdom—April 9, 1930 [1 a b 5]
Upper Volta—March 3, 1971
Venezuela—Feb. 8, 1928
Yemen (San'a)—March 17, 1971
Yugoslavia—April 12, 1929 [1 b]
Zambia [1 a b 2]

[1 a b c d] With reservations to Protocol as follows:
[a] Binding only as regards relations with other parties.
[b] To cease to be binding in regard to any enemy States whose armed forces or allies do not observe provisions.
[c] To cease to be binding as regards use of chemical agents with respect to any enemy State whose armed forces or allies do not observe provisions.
[d] Does not constitute recognition of or involve treaty relations with Israel.

[2] By virtue of agreement with former parent State or notification to the Secretary-General of the United Nations of succession to treaty rights and obligations upon independence.

[3] Applicable to all French territories.

[4] Applicable to Surinam and Curaçao.

[5] It does not bind India or any British Dominion which is a separate member of the League of Nations and does not separately sign or adhere to the Protocol. It is applicable to all colonies.

Reservations of Parties to the Geneva Protocol of 1925

Australia

Subject to the reservations: That the said protocol shall be binding on His Majesty only with respect to the Powers and States which have signed and ratified it or which have acceded to it, and that the said protocol shall cease to be binding on His Majesty with respect to any enemy Power the armed forces of which or the armed forces allied with which fail to respect this protocol.

Belgium

1. The said protocol shall bind the Belgian Government only with respect to the States which have signed and ratified it or which have acceded to it;
2. The said protocol shall automatically cease to be binding on the Belgian Government with respect to any enemy State whose armed forces or whose allies fail to respect the interdictions which form the subject of this protocol.

British Empire

1. The said protocol shall be binding on His Britannic Majesty only with respect to the Powers and States which have signed and ratified it or which have acceded to it permanently;
2. The said protocol shall cease to be binding on His Britannic Majesty with respect to any enemy Power the armed forces of which or the armed forces allied with which fail to respect the interdictions which form the subject of this protocol.

Bulgaria

1. The said protocol shall be binding on the Bulgarian Government only with respect to the States which have signed and ratified it or which have acceded to it;
2. The said protocol shall automatically cease to be binding on the Bulgarian Government with respect to any enemy State whose armed forces or whose allies fail to respect the interdictions which form the subject of this protocol.

Canada

1. The said protocol shall be binding on His Britannic Majesty only with respect to the States which have signed and ratified it or which have acceded to it permanently.
2. The said protocol shall cease to be binding on His Britannic Majesty with respect to any enemy State whose armed forces or whose allies *de jure* or *de facto* fail to respect the interdictions which form the subject of this protocol.

Chile

1. The said protocol shall be binding on the Chilean Government only with respect to the States which have signed and ratified it or which have acceded to it permanently;
2. The said protocol shall automatically cease to be binding on the Chilean Government with respect to any enemy State whose armed forces or whose allies fail to respect the interdictions which form the subject of this protocol.

China, People's Republic of

The People's Republic of China has bound itself to apply the protocol "subject to reciprocity on the part of all other contracting and acceding Powers."

33-749 O—74——25

Czechoslovakia

The Czechoslovak Republic will cease *ipso facto* to be bound by this protocol with respect to any State whose armed forces or the armed forces of whose allies fail to respect the interdictions prescribed in this protocol.

Estonia

1. The said Protocol is only binding on the Estonian Government as regards States which have signed or ratified it or which may accede to it.
2. The said Protocol shall *ipso facto* cease to be binding on the Estonian Government in regard to any enemy State whose armed forces or whose allies fail to respect the prohibitions laid down in the Protocol.

France

1. The said protocol shall be binding on the Government of the French Republic only with respect to the States which have signed and ratified it or which have acceded to it;
2. The said protocol shall automatically cease to be binding on the Government of the French Republic with respect to any enemy State whose armed forces or whose allies fail to respect the interdictions which form the subject of this protocol.

India

1. The said protocol shall be binding on His Britannic Majesty only with respect to the States which have signed and ratified it or which have acceded to it permanently;
2. The said protocol shall cease to be binding on His Britannic Majesty with respect to any enemy Power the armed forces of which or the armed forces allied with which fail to respect the interdictions which form the subject of this protocol.

Iraq

The Iraqi Government shall be bound by the provisions of the protocol only with respect to the States which have both signed and ratified it or which have acceded to it, and shall not be bound by the protocol with respect to any enemy State whose armed forces or whose allies fail to respect the provisions of the protocol.

Ireland

The Government of the Irish Free State intends to assume by this accession no obligation save with respect to the States which have signed and ratified the said protocol or which have acceded to it permanently and, in case the armed forces of an enemy State or of an ally of such State fail to respect the said protocol, the Government of the Irish Free State shall cease to be bound by the said protocol with respect to such State.

Israel

The said protocol shall be binding on the State of Israel only with respect to the States which have signed and ratified it or which have acceded to it.

The said protocol shall cease *ipso facto* to be binding on the State of Israel with respect to any enemy State whose armed forces, or the armed forces of whose allies, or the regular or irregular forces or the groups or individuals operating from its territory fail to respect the interdictions which form the subject of this protocol.

Kuwait

The accession of the State of Kuwait to this Protocol in no way implies recognition of Israel or establishment with that country of relations governed by this Protocol.

In case of violation of the prohibition mentioned in this Protocol by any one of the Parties, the State of Kuwait shall not be required to apply the provisions of this Protocol with respect to the Party having committed such violation.

Libya

Accession to the Protocol does not imply recognition of or establishment of any relations whatsoever with Israel.

This Protocol shall be binding upon the Libyan Arab Republic only vis-a-vis the States actually bound by it and shall cease to be binding upon the Libyan Arab Republic with respect to States whose forces or allied armed forces do not respect the prohibitions which are the subject of this Protocol.

MONGOLIAN PEOPLE'S REPUBLIC

In case of violation of this prohibition by any State whatsoever with respect to the Mongolian People's Republic or to its allies, the Mongolian People's Republic shall not consider itself bound by the obligations of the Protocol with respect to that State.

NETHERLANDS

This protocol, as regards the use in war of asphyxiating, poisonous, or other gases, and any similar liquids, materials, or processes, shall automatically cease to be binding on the Royal Government of the Netherlands with respect to any enemy State whose armed forces or whose allies fail to respect the interdictions which form the subject of this protocol.

NEW ZEALAND

Subject to the reservations: That the said protocol shall be binding on His Majesty only with respect to the Powers and States which have signed and ratified it or which have acceded to it, and that the said protocol shall cease to be binding on His Majesty with respect to any enemy Power the armed forces of which or the armed forces allied with which fail to respect this protocol.

NIGERIA

The protocol shall be binding on Nigeria only with respect to the States actually bound by it and shall cease to be binding on Nigeria with respect to States the forces of which or the armed forces allied with which fail to respect the interdictions which form the subject of this protocol.

PORTUGAL

1. The said protocol shall be binding on the Government of the Portuguese Republic only with respect to the States which have signed and ratified it or which have acceded to it;

2. The said protocol shall automatically cease to be binding on the Government of the Portuguese Republic with respect to any enemy State whose armed forces or whose allies fail to respect the interdictions which form the subject of this protocol.

ROMANIA

1. The said protocol shall be binding on the Royal Government of Romania only with respect to the States which have signed and ratified it or which have acceded to it permanently;

2. The said protocol shall cease to be binding on the Royal Government of Romania with respect to any enemy State whatsoever whose armed forces or whose allies *de jure* or *de facto* fail to respect the interdictions which form the subject of this protocol.

SOUTH AFRICA

Subject to the reservations: that the said protocol shall be binding on His Majesty only with respect to the Powers and States which have signed and ratified it or which have acceded to it, and that the said protocol shall cease to be binding on His Majesty with respect to any enemy Power the armed forces of which or the armed forces allied with which fail to respect this protocol.

SPAIN

Declares that it recognizes as automatically binding, without special convention with respect to any Member or State accepting and observing the same obligation, that is to say, subject to reciprocity, the Protocol for the Prohibition of the Use in War of Asphyxiating, Poisonous, or other Gases, and of Bacteriological Methods of Warfare, signed at Geneva on June 17, 1925.

SYRIA

The accession of the Syrian Arab Republic to this protocol and its ratification by its Government shall in no case signify recognition of Israel and could not lead to establishing relations with the latter concerning the provisions prescribed by this protocol.

U.S.S.R.

1. The said protocol shall be binding on the Government of the Union of Soviet Socialist Republics only with respect to the States which have signed and ratified it or which have acceded to it permanently;

2. The said protocol shall cease to be binding on the Government of the Union of Soviet Socialist Republics with respect to any enemy State whose armed forces or whose allies *de jure* or *de facto* fail to respect the interdictions which form the subject of this protocol.

YUGOSLAVIA

The said protocol shall automatically cease to be binding on the Government of the Serbs, Croats, and Slovenes with respect to any enemy State whose armed forces or whose allies fail to respect the interdictions which form the subject of this protocol.

French Text of the Geneva Protocol of 1925

PROTOCOLE

LES PLÉNIPOTENTIAIRES SOUSSIGNÉS, au nom de leurs Gouvernements respectifs :

Considérant que l'emploi à la guerre de gaz asphyxiants, toxiques ou similaires, ainsi que de tous liquides, matières ou procédés analogues, a été à juste titre condamné par l'opinion générale du monde civilisé.

Considérant que l'interdiction de cet emploi a été formulée dans des traités auxquels sont Parties plupart des Puissances du monde,

Dans le dessein de faire universellement reconnaître comme incorporée au droit international cette interdiction, qui s'impose également à la conscience et à la pratique des nations,

déclarent:

Que les Hautes Parties Contractantes, en tant qu'elles ne sont pas déja Parties à des traités prohibant cet emploi, reconnaissent cette interdiction, acceptent d'étendre cette interdiction d'emploi aux moyens de guerre bactériologiques et conviennent de se considérer comme liées entre elles aux termes de cette déclaration.

Les Hautes Parties Contractantes feront tous leurs efforts pour amener les autres États à adhérer au présent Protocole. Cette adhésion sera notifiée au Gouvernement de la République française et, par celui ci, à toutes les Puissances signataires et adhérentes. Elle prendra effet à dater du jour de la notification faite par le Gouvernement de la République français.

Le présent Protocole, dont les textes français et anglais feront foi, sera ratifié le plus tôt possible. Il portera la date de ce jour.

Les ratifications du présent Protocole seront adressés au Gouvernement de la République française, qui en notifiera le dépôt à chacune des Puissances signataires ou adhérentes.

Les instruments de ratification ou d'adhésion resteront déposés dans les archives du Gouvernement de la République française.

Le présent Protocole entrera en vigueur pour chaque, Puissance signataire à dater du dépot de sa ratification et, dès ce moment, cette Puissance sera liée vis-à-vis des autres Puissance ayant déjà procedé au dépot de leurs ratifications.

United Nations Resolution 2603 A (XXIV) of December 16, 1969

Resolution 2603 A (XXIV)

Adopted on 16 December 1969 by the General Assembly, by a vote of 80 to 3 with 36 abstentions:

"*The General Assembly,*

Considering that chemical and biological methods of warfare have always been viewed with horrow and have been justly condemned by the international community,

Considering that these methods of warfare are inherently reprehensible, because their effects are often uncontrollable and unpredictable and may be injurious without distinction to combatants and non-combatants and because any use would entail a serious risk of escalation,

Recalling that successive international instruments have prohibited or sought to prevent the use of such methods of warfare,

Nothing specifically in this regard:

(a) That the majority of States then in existence adhered to the Protocol for the Prohibition of the Use in War of Asphyxiating, Poisonous or Other Gases, and of Bacteriological Methods of Warfare, signed at Geneva on 17 June 1925,

(b) That since then further States have become Parties to that Protocol,

(c) That yet other States have declared that they will abide by its principles and objectives,

(d) That these principles and objectives have commanded broad respect in the practice of States,

(e) That the General Assembly, without any dissenting vote, has called for the strict observance by all States of the principles and objectives of the Geneva Protocol,

Recognizing therefore, in the light of all the above circumstances, that the Geneva Protocol embodies the generally recognized rules of international law prohibiting the use in international armed conflicts of all biological and chemical methods of warfare, regardless of any technical developments,

Mindful of the report of the Group of Experts, appointed by the Secretary-General of the United Nations under General Assembly resolution 2454 A (XXIII) of 20 December 1968, on chemical and bacteriological (biological) weapons and the effects of their possible use,

Considering that this report and the foreword to it by the Secretary-General add further urgency for an affirmation of these rules and for dispelling for the future, any uncertainty as to their scope and, by such affirmation, assure the effectiveness of the rules and enable all States to demonstrate their determination to comply with them,

Declares as contrary to the generally recognized rules of international law, as embodied in the Protocol for the Prohibition of the Use in War of Asphyxiating, Poisonous or Other Gases, and of Bacteriological Methods of Warfare, signed at Geneva on 17 June 1925, the use in international armed conflicts of:

(a) Any chemical agents of warfare—chemical substances, whether gaseous, liquid or solid—which might be employed because of their direct toxic effects on man, animals or plants;

(b) Any biological agents of warfare—living organisms, whatever their nature, or infective material derived from them—which are intended to cause disease or death in man, animals or plants, and which depend for their effects on their ability to multiply in the person, animal or plant attacked."

Voting record

(Italicized entries are those countries which were parties to the Geneva Protocol at the time of voting.)

In favour:

Afghanistan, Algeria, *Argentina*, Brazil, *Bulgaria*, Burma, Burundi, *Byelorussian Soviet Socialist Republic*, Cameroon, Central African Republic, *Ceylon*,

Chad, Colombia, Congo (Brazzaville), Congo (Democratic Republic), Costa Rica, *Cuba*, *Cyprus*, *Czechoslovakia*, Dahomey, Dominican Republic, Ecquador, Equatorial Guinea, *Ethiopia*, *Finland*, Gabon, *Ghana*, Guatemala, Guinea, Guyana, Haiti, Honduras, *Hungary*, *India*, Indonesia, *Iran*, *Iraq*, *Ireland*, Ivory Coast, Jamaica, Jordan, Kenya, Kuwait, *Lebanon*, Lesotho, Libya, *Maldives*, Mali, Mauritania, Mauritius, *Mexico*, *Mongolia*, Morocco, *Nepal*, *Niger*, *Nigeria*, *Pakistan*, Panama, Peru, *Poland*, *Romania*, *Rwanda*, Saudi Arabia, Senegal, Somalia, Southern Yemen, *Spain*, Sudan, *Sweden*, *Syria*, Togo, Trinidad and Tobago, *Uganda*, *Ukrainian Soviet Socialist Republic*, *Union of Soviet Socialist Republics*, *United Arab Republic*, *United Republic of Tanzania*, Upper Volta, Yemen, *Yugoslavia*.

Against:

Australia, *Portugal*, United States of America.

Abstaining:

Austria, *Belgium*, Bolivia, *Canada*, *Chile*, *China (Taiwan)*, *Denmark*, El Salvador, *France*, *Greece*, *Iceland*, *Israel*, *Italy*, Japan, Laos, *Liberia*, *Luxembourg*, *Madagascar*, Malawi, Malaysia, *Netherlands*, *New Zealand*, Nicaragua, *Norway*, *Paraguay*, Philippines, *Sierra Leone*, Singapore, *South Africa*, Swaziland, *Thailand*, *Tunisia*, *Turkey*, *United Kindom of Great Britain and Northern Ireland*, Uruguay, *Venezuela*.

Absent:

Albania, Barbados, Botswana, Cambodia, *Gambia*, Malta, Zambia.

Report From the Pugwash Chemical Warfare Workshop, Helsinki, Finland, April 16–18, 1974

Introduction

There has been practically no progress in resolving the problems of a treaty concerning the prohibition of chemical weapons at the CCD level during the past two years. The dangers of such a continuing impasse grow daily because of the recent development of weapons which are now, or may shortly become, militarily operational, notably "binary" weapons. It should be noted as well that ratification of the Geneva Protocol of 1925 has not been achieved as yet in the USA, and even ratification of the agreement on BW has not been obtained to date from any of the major powers. We therefore call upon the authorities of these countries, and of other countries which have not yet done so, to ratify these agreements as soon as possible. By doing so the present impasse could well be broken, and progress will be appreciably accelerated towards the complete abolition of chemical weapons, which is urgently needed.

At an informal CCD meeting there was suggested the need for meetings of experts to develop uniform rules and standards by which National Controls would be exercised in the case of organophosphorus compounds. (This is discussed further below.)

The strong effort of the international working group at SIPRI, 1971–1972, on verification of a CW-treaty, resulted in adoption in principle of a plan for a verification system, based on combined national and international provisions, which would greatly reduce the need for international on site inspections.

The Group notes with regret that Pugwash has been relatively inactive in the CW field during this period of impasse.

The Pugwash Working Group on CW notes the present need for increasing the effort [1] in this field and therefore strongly recommends that a continuing effort be undertaken by the Pugwash Study Group, SIPRI and other organs in the CW field, to explore in depth certain of the major obstacles in the CCD negotiations for a CW treaty.

Background

By their existence and hence the possibility of their use, chemical weapons, in particular nerve gas, represent a threat to the security of nations. Even though the use of nerve gas in war is proscribed by customary and conventional international law, a small number of countries currently possess nerve-gas stockpiles. They do so, evidently, on the supposition that the threat of nerve gas to national security is best countered by a posture of counter-threat, by a retaliatory capability serving as a deterrent. It is the opinion of the Pugwash CWSG that insufficient attention has so far been paid within the military communities of these countries to the competing merits of alternative security measures.

One such measure consists of attempting to remove the threat altogether by means of internationally-negotiated chemical disarmament. Such disarmament is being opposed within military circles on the grounds that it would be impossible to ensure an adequate degree of verification. Because of this, it is argued, a like-with-like deterrent posture must be maintained.

In the opinion of the Pugwash CWSG, the demands which are currently being made in some quarters with regard to verification are unreasonably heavy. The Group therefore advocates a serious and detailed examination within Governments of the following proposition: that it is the function of verification to assure the benefits to security, *no more and no less*, of replacing a policy of chemical deterrence by participation in international chemical disarmament. The suggestion here is that verification procedures which provide the same degree of security as

[1] We note, for example, that no attention is being paid to this subject this year at the Italian Summer School on Disarmament and Research on Conflicts, which is sponsored by Pugwash.

that provided by chemical deterrence should be seen as representing the least that is acceptable; and that if the verification machinery provides any greater degree of security, there can be no logic on abstaining from chemical disarmament.

Within the context of the technically advanced nations, a relatively modest degree of verification may be adequate. (On this, see Annex 3 by J. P. Perry Robinson.) For other nations, vertification is not only needed to meet more stringent security requirements, but it would also serve as a constraint on proliferation.

Yet although considerably less than 100% assurance of chemical disarmament would satisfy security requirements, it is by no means obvious what degree of verification would in practice be adequate. This is clearly a matter for further study, both at a technical level, and at a political level. (On this, see the Annex by J. Prawitz.) There are two complicating factors:

The first is the imminent possibility of binary nerve-gas weapons appearing in the arsenals of the United States. This development has particularly grave implications. The credibility of the United States in the CCD chemical-disarmament negotiations is already at a low ebb; and it seems entirely possible that the spectacle of a new round of US nerve-gas weapons procurement will kill the negotiations completely. Moreover, binaries make no sense at all in security terms unless they are "pre-positioned" in Europe; the shipment of large tonnages of US nerve-gas weapons into Europe can scarcely fail to impede the current negotiations for the reduction of tensions and military forces in Europe.

The second complication is that nerve gas represents a much greater security threat to nations outside the nuclear umbrella than it does to those within it. Since it seems to be the case that nerve gas is today possessed only by certain of the nuclear powers, pressures for nerve-gas proliferation may well exist.

It is also to be noted that the appearance of binary nerve-gas technology has increased the likelihood of proliferation by making nerve-gas weapons economically and technologically more accessible.

The above considerations in our view argue very strongly in favour of efforts to eliminate chemical weapons through an international treaty.

The Problem of Verification

The verification system in a treaty prohibiting chemical weapons should be a combination of national and international measures which would complement and supplement each other, and provide an acceptable system which would ensure effective implementation of the prohibition.

In view of the close and specific relationship between the production of chemical substances for military and for peaceful purposes, any international verification of an agreement on prohibition of the development, production and stockpiling of chemical weapons and their destruction, although affording difficulties, cannot be separated from national verification procedures and the reporting of results of such procedures to an international authority.

A. National verification

Governments of States parties to the treaty would be able to ensure national control by adopting such measures as, for example, the establishment of national control committees. These could include e.g., representatives of the government, the press, trade unions, scientific and public organizations, prominent scholars, scientists of international standing, and other representatives, depending on the local conditions prevailing in each country.

These national control committees should include expert analysts, toxicologists and economists to analyse statistical data. The work of these expert analysts, toxicologists and economists should be based on an internationally agreed programme, including the necessary rules and standards.

This programme could be drawn up and adopted at an international meeting of experts. The establishment of such a uniform programme would make it possible to eliminate errors both in taking of samples and in their subsequent analysis. We believe that the effectiveness of this control would be ensured by the modern methods available to expert chemists, such as instruments for detection and analysis of the effluent gases of different production processes, analysis of effluent waters and the soil of certain undertakings, and inspection of these undertakings by competent specialists.

The technical components of international rules and standards for such an undertaking by national control authorities for verification is an eminently suitable subject for in-depth study by the Pugwash Study Group on CW.

An important part of the verification system could consist in statistical calculation of the consumption of input materials which could serve for the manfacture of single- and dual-purpose chemical-warfare products. Potential input materials for the production of chemical weapons might be said to include, for example such substances as elementary phosphorus, ethylene- and propylene-oxides, phosgene, hydrogen fluoride and a number of other substances.

As new potential chemical weapons appear, this list of products for statistical accounting could be supplemented and amended.

Further elements of elaboration of a national control system should also be expored by the Pugwash Study Group on CW.

B. INTERNATIONAL VERIFICATION

The national control system should be supplemented by international provisions for exchange of information between governments regarding all facts relevant to chemicals and techniques which can be used for the production of actual and potential CW agents. This exchange of information should also cover new products and new directions of research, including incidental scientific discoveries.

The problem of international verification, including on-site visits, is certainly the outstanding obstacle. Therefore we strongly recommend that the subject of international verification be given priority attention by the Pugwash Study Group.

PROPOSED TOPICS FOR THE PUGWASH CW STUDY GROUP

(1) The organizational aspects of the international verification apparatus.

(2) Functions to be performed by the international organization.

(3) The provisions for interaction between the international and national verification organizations.

A departure point for such examinations may be provided by the suggestions contained in a working document prepared for the present meeting *Verification of Chemical Weapons Bans—An approach, its construct, effectiveness, and acceptability.*

(4) Disposal of chemical weapons stockpiles and possible redeployment of research production and storage facilities.

(5) A critical evaluation of the results at the International Symposium on Preventive and Therapeutic Measures in Poisoning by Anticholinesterase Compounds (to be held at Herzegnovi, Yugoslavia, 6–10 October, 1974) to decide whether a continuing international effort on this subject is warranted.

(6) The possibility of international co-operation in the research and development of means and methods of protection against CW attack.

(7) Early identification of CW candidate agents or trends towards them by literature search or other indications (See Annex by R. B. Fisher).

Dissemination of Information

Public discussions of CW disarmament problems should be revived. One way of helping to do this would be to organize the distribution of all relevant publications to key experts (participants in CCD expert meetings, in SIPRI symposia, and in Pugwash CW discussions), and to request that they write articles on the particular problems on which they are expert.

Annex 1

TIME LAG BETWEEN DISCOVERY OF CANDIDATE CW AGENTS AND THEIR APPEARANCE IN MILITARY ARSENALS

It is often taken for granted that any highly poisonous chemical can be used in warfare and that this use can commence shortly after the discovery of the chemical. This view is reinforced by knowledge of the number of chemicals which have been proposed as chemical warfare agents.

But the requirements which have to be met to cause recommendation of a chemical as a CW agent in modern warfare are numerous and stringent. Indeed, if an attempt began today to find out whether a newly discovered highly toxic chemical could be used for chemical warfare, years would elapse before it could be decided whether to put it into weapons. Its toxicity by inhalation and through the skin would have to be determined, and the possible long-term ill-effects of low doses. Possible methods of dissemination, which are dependent on its physical

and chemical properties, would have to be examined. Methods of large-scale manufacture would have to be studied. The physical and chemical properties of the manufactured products (which would most probably not be chemically pure) would have to be examined. In particular, the stability over long periods of time of its chemical and physical properties in all likely conditions of storage (in bulk and in weapons) would have to be determined.

It is unlikely that candidate agents would come fully up to hopes or requirements in all these examinations.

Possible means of overcoming apparent disadvantages would have to be explored. Ultimately, extensive field tests of weapons filled with the candidate agent would be essential to enable ordinance experts to draw up the detailed instructions to the military users of the weapons which would be essential if commanders were to be given any assurance of the effects of the weapons.

The V-agents have unusually favourable combinations of physical and chemical properties for the purpose of chemical warfare, and they are the result of developments originating in the G-agents which had already been accepted as CW agents. Although, as a consequence, some of the studies could be curtailed the interval between the discovery of these very toxic chemicals and their acceptance as CW agents was about four years.

It could be argued that technology has advanced so far in the intervening years that development could now be accelerated greatly. But, in fact, much fuller knowledge than previously would now be required before deciding on the value of a potential new agent for the filling of modern weapons, because of the advances in weapon technology.

Thus, there is no necessary connection between the discovery of new "super-toxic" chemicals and the emergence of new CW agents, and it can confidently be predicted that there will always be a long interval between the emergence in public of knowledge of the discovery of a new toxic chemical and its utilisation, if it is suitable, as a CW agent. Control of the emergence of new agents may therefore be assisted by steps which could be taken after the acquisition of knowledge of new chemicals based on a literature search, or from other indications.

Annex 2

ON A BALANCED TREATY STRUCTURE

The most difficult problem in drafting a CW-ban is verification. In solving this problem it will be necessary to define what the verification procedure is expected to produce. This in turn is dependent on what the exact purpose of the treaty will be. There would, of course, be little meaning in producing a lot of evidence and information that is not needed for the political process of watching the implementation of the treaty and documents related to it. Clearly, verification measures should not be more extensive than is necessary to create sufficient warning time for the proper organization of peace-supporting activities. A balance between all the provisions and the verification would thus be very desirable.

An accommodation of the treaty provisions to geographical circumstances may also be of interest, e.g. in regard to verification (compare the NPT). The military role of CW is, of course, different in theatres dominated by nuclear forces as opposed to other regions, where they could play the role of ultimate weapons.

The items to be discussed and evaluated for making a balanced draft CW-ban would be:

I. Ban of use (1925 Geneva Protocol):

(*a*) Further accessions.

(*b*) Withdrawing of reservations.

II. Ban of research, development and possession (CW-ban), the scope of the ban and its phasing in.

III. Verification:

(*a*) In nuclear weapon dominated regions.

(*b*) Other regions.

(*c*) What can national means of verification provide.

(*d*) What additional treaty-based internationally operated verification is necessary.

IV. Security guaranties:

(*a*) Security Council guaranties (similar to NPT).

(*b*) Political assistance to victims attacked with CW.

(*c*) Medical and rescue assistance to such victims.

(*d*) National protection measures.

(*e*) Retaliation in case the treaty permits stockpiles to be retained.

Clearly, an overall analysis of all these elements of a CW-ban would be desirable. However, the problems of technical verification and protective measures are particularly suitable for further and comprehensive Pugwash considerations.

Annex 3

SECURITY LIMITATIONS OF CHEMICAL DETERRENCE

Within the context of the superpower confrontation in Europe, it is arguable that a policy of chemical deterrence does not in fact enhance national security by very much; chemical weapons disarmament with a relatively modest degree of considerations:

(*a*) *The low probability of chemical warfare being initiated.*—Even if nuclear weapons were not used from the outbreak of hostilities, any form of armed conflict in Europe would carry with it the risk of nuclear warfare. The use of chemical weapons is illegal and internationally condemned; resort to it even on a small and localized scale would indicate that the belligerent concerned intended to pursue his war aims by extreme measures. Because this would generate pressure for a correspondingly extreme response, the risk of escalation to nuclear warfare would be particularly great.

(*b*) *The widespread deployment of protective equipments against chemical weapons.*—Nerve gas could have devastating effects if used against combat units caught by surprise in a low protective posture. But any subsequent attacks would be directed against an alerted enemy; and present-day protective equipments can blunt any nerve-gas attack directed against them. Moreover, new forms of protection are currently under development which may soon provide virtually complete protection against any nerve-gas attack that may be logistically feasible on the battlefield. Because there could therefore be no certainty of inflicting major damage by retaliating in kind against nerve-gas attack, the possibility of such retaliation would not be a strong deterrent. Retaliation-in-kind would undoubtedly force the initiator into full protective posture (in the rather unlikely event that he was not in it already), but the suggestion that this would be an advantageous, or even a deterring, end in itself—that there would then be no significant disparity between the two sides as regards impediments to fighting efficiency imposed by protective clothing and respirators—seems to under-rate the increasing reliance that is being placed in modern armies on armoured fighting-vehicles and personnel-carriers equipped with CB air filters.

(*c*) *The increasing availability of "conventional" weapons which can match the military assets of nerve-gas weapons.*—Recent developments in blast, fragmentation and flame techniques provide an area-effectiveness comparable to that of nerve gas; and newly developed mine-warfare techniques provide a comparable area-denial capability. Protection against these weapons is considerably more difficult than protection against nerve gas. This means, first, an increase in the improbability of resort to chemical warfare, and, second, the availability of retaliatory options that make greater military sense than that of retaliation in kind.

Yet although it follows that very considerably less than 100% assurance of chemical disarmament would satisfy security requirements, it is by no means obvious what degree of verification would in practice be adequate. This is clearly a matter for further study, both at a technical level, and at a political level.

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