

THE GENEVA PROTOCOL OF 1925

HEARINGS
BEFORE THE
COMMITTEE ON FOREIGN RELATIONS
UNITED STATES SENATE
NINETY-SECOND CONGRESS
FIRST SESSION
ON
EXECUTIVE J, 91ST CONGRESS, 2D SESSION
THE PROTOCOL FOR THE PROHIBITION OF THE USE IN WAR
OF ASPHYXIATING, POISONOUS, OR OTHER GASES, AND
OF BACTERIOLOGICAL METHODS OF WARFARE

MARCH 5, 10, 18, 19, 22, AND 26, 1971

[Although these hearings were held in March 1971, they were not printed until October 1972 for the reasons stated in the Foreword.]



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(II)

12-1882

FOREWORD

A year and a half ago, in March, 1971, the Committee on Foreign Relations held extensive hearings on the Geneva Protocol of 1925, which the President had resubmitted for the Senate's advice and consent. Following those hearings the Committee expressed to the President its strong support for the objectives of the Protocol but asked the President to reconsider the Administration's interpretation that the Geneva Protocol does not prohibit the use of tear gas and herbicides in warfare.

These views were set forth in a letter which I sent to the President on behalf of the Committee on April 15, 1971. (A copy of this letter appears in the appendix to the hearings on page 432.) In the same letter, the Committee expressed its desire to have available to it before acting on the Protocol several studies then in progress within the Executive Branch relating to the use of herbicides and tear gas in Vietnam and their possible utility in other situations. Our letter also indicated that the Committee would await the President's response before taking further action on the Protocol.

More than 16 months have passed since the Committee wrote to the President. To date we have received no substantive reply. The Committee initially delayed publication of these hearings in the expectation of a response from the Executive Branch which would provide a basis for the resumption of hearings. Because the Committee still has received neither a substantive response to its letter nor any indication that one will be forthcoming, and because the end of the current session of Congress is rapidly approaching, there appears to be no justification for further delay in publishing these hearings.

Since March, 1971, there have been several developments related to the issues raised in the hearings. Despite assurances given by the Secretary of State to the Committee that American military use of herbicides in Vietnam would be phased out, the use of herbicides by American forces has been reduced but not eliminated. Similarly, the use of tear gas, particularly of the potent CS2 form, also continues, both by American and by South Vietnamese forces, the latter being trained and supplied by the Americans. There have also been reports of the use of tear gas by the North Vietnamese, this being the almost inevitable and, indeed, the predicted consequence of our own use of such gas.

During this interim period there have also been positive developments relating to the control of chemical and biological weapons. The United States and many other nations have concluded a Convention for the Prohibition of Development, Production and Stockpiling of Bacteriological and Toxin Weapons. This treaty was signed in Washington on April 10, 1972, and was submitted to the Senate for its advice and consent on August 10, 1972. In addition, discussion has now begun in the U.N. Conference of the Committee on Disarmament at Geneva regarding a chemical weapons convention.

It is unfortunate that while these efforts have been going forward that the Administration has not demonstrated any interest in removing the cloud which it has placed over the Geneva Protocol by virtue of its interpretation regarding tear gas and herbicides. This inflexi-

bility coupled with the fact of our continued use of these agents in Vietnam threatens to undermine the ultimate effectiveness of the new conventions.

The preamble of the Bacteriological Convention reaffirms the significance of the Geneva Protocol as the foundation for subsequent international agreements in this area. Most nations of the world take the view that our use of tear gas and herbicides in Vietnam is contrary to the provisions of the Geneva Protocol. Indeed, the preamble of the Convention specifically notes that the General Assembly "has repeatedly condemned all actions contrary to the principles and objectives" of the Protocol. It is difficult in light of these circumstances to see how the United States adherence to the Convention can be reconciled with the Administration's rejection of the universally accepted interpretation of the Protocol.

In my view it is regrettable that the Executive Branch has ignored the Committee's efforts to resolve the difficulties posed by its interpretation of the Protocol. It is now more important than ever that the Executive Branch come to grips with the question of U.S. adherence to the Protocol in order that this issue not complicate consideration of the Bacteriological Convention.

The Executive Branch studies relating to tear gas and herbicides which the Secretary of State told the Committee were in progress at the time of the 1971 hearings are reported to have been completed. Yet to date none of these studies has been made available to or discussed with the Committee.

Similarly the Executive Branch has ignored the Committee's requests for its comments on two proposals relating to the interpretation of the Geneva Protocol. S. Res. 154 and S. Res. 158, introduced by Senators Humphrey and Brooke in July, 1971. (The texts of these resolutions appear on pages 438 and 436 of the appendix.) While the Committee has not taken a position on these resolutions and could hardly be expected to do so in the face of continued Executive Branch silence, these resolutions do represent constructive efforts to resolve the question of the Protocol's interpretation.

We are hopeful that the appearance of these hearings coupled with the President's submission of the Bacteriological Convention to the Senate will stimulate new interest on the part of the public and the Executive Branch in full U.S. adherence to the Geneva Protocol. It would appear that the only impediment to such progress is the reluctance of the Administration to forego the option to employ tear gas and herbicides in future wars. It is difficult to reconcile this position with our knowledge that their military utility is open to serious question, that their actual use in Vietnam is undermining the restraints inherent in the Geneva Protocol, and that the opprobrium which attaches to their use is nearly universal.

A decision on the part of the Administration to seek ratification of the Geneva Protocol without any special exceptions for the use of herbicides and tear gas in warfare would, in my view, be a constructive act. A renunciation of the option to use these weapons would not adversely affect our national security and, indeed, it would represent the single greatest contribution which our nation could make now to the creation of truly effective and universal barriers against one of the most repugnant of all forms of warfare.

J. W. FULBRIGHT, *Chairman.*

OCTOBER 3, 1972.

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Now if there is some possibility, as you indicate, of having the administration accept the interpretation that harassing agents are embraced under the protocol by waiting and observing this report, then perhaps the sensible course at the moment would be to wait and see if their position on this matter does not change.

The CHAIRMAN. It is quite natural that any administration, if it has been using an agent, does not like at the same time to say that it is wrong to use it. But I do not think they ought to do that. The fact that you have done things in the past before you have ever ratified the protocol should not be held against anyone for agreeing to ratify in the future. Goodness knows, the administration itself has proposed this and I can imagine if the war gets further along and there is no longer any use whatever of herbicides and gases that it is easier for them then to accept.

Dr. BRENNAN. I should think so.

The CHAIRMAN. Of course, I do not know what is going to happen with the course of the war, but we can judge that from now on.

COMMITTEE'S JUDGMENT CONCERNING POSSIBILITY OF RATIFICATION

I agree with you. You said you are not an expert in maneuvering. I am not sure that any of us are, but that is a matter that is essentially for the committee to judge whether or not it can be ratified.

I would agree with you that the last thing we want to do is bring it up and have it turned down, but I think we ought to be able to ascertain that fairly well before it is established. You are never sure, but you can come pretty close to ascertaining.

Dr. BRENNAN. I should think you would be in the best position to judge that.

The CHAIRMAN. I think we could probably judge that.

Further, we ought to be able to ascertain whether or not, if the Senate ratifies it, that then the President will go ahead. All we do is consent to its ratification. Whether or not he would then be so determined that he would not proceed to ratification if we did not adopt his understanding is another matter that nobody can tell until we get down to the point of doing.

Thank you very much, Dr. Brennan. I think your testimony is a real contribution to our consideration of the protocol, and I think it is very important.

Dr. BRENNAN. Well, thank you for hearing me, sir.

The CHAIRMAN. Thank you very much.

Our next witness is Dr. Matthew Meselson, professor of biology of Harvard University.

We are very pleased to have you, Dr. Meselson. You have a prepared statement, I believe.

Dr. MESELSON. Yes, I do, Mr. Chairman.

The CHAIRMAN. Will you proceed, sir.

STATEMENT OF DR. MATTHEW MESELSON, PROFESSOR OF BIOLOGY, HARVARD UNIVERSITY

Dr. MESELSON. I am extremely glad to appear before you today as you consider the Geneva Protocol of 1925 prohibiting gas and germ warfare. Our country's position regarding this category of weapons is

very different from what it was 2 years ago, when I was privileged to come before this committee in executive session to discuss chemical and biological weapons and their implications for national security. At that time our policies were ambiguous and our weapons programs had taken on a momentum of their own, insufficiently guided by careful analysis of our national interest. It is greatly to the credit of President Nixon and members of his administration that this dangerous trend has been reversed. Their detailed study and analysis, conducted over a period of more than a year, has given high authority to what is widely sensed by the ordinary citizen: Our overriding interest is to reinforce the worldwide restraints against gas and germ warfare. All of the new steps announced by the President have been in this direction—the renunciation of all possession and use of germ and toxin weapons; the reaffirmation of our no-first-use pledge for lethal chemical weapons and its extension to include incapacitating chemical weapons as well; and the submission of the Geneva Protocol to the Senate.

When the administration began its extensive review, it was faced with a situation in which certain chemical weapons were already in use. Beginning in the early years of our involvement in Vietnam, the use of herbicides and riot gas had grown to very large proportions. But even here there has been an important change. The use of herbicides is now being phased out and the employment of riot gas has fallen to a small fraction of what it once was. Nevertheless, the Geneva Protocol has been submitted to the Senate with a statement by the Secretary of State that it does not apply to herbicides and riot gas.

We can understand the reluctance to undertake a no-first-use pledge for weapons so recently and extensively used by our forces. Our concern, however, should not be for what is now rapidly receding but, rather, for the state of things during the years to come; the ratification of a treaty should try to construct the future rather than justify the past. It is in this spirit that I wish to talk with you in particular about the implications to the United States of our future attitude toward the use in war of riot gas.

PROBLEMS PRESENTED BY MILITARY USE OF HERBICIDES

Let me digress for a moment, Mr. Chairman, and say parenthetically that although the military use of herbicides possesses some of the same implications, it also presents special problems of its own and this very important subject merits separate consideration.

I might add, however, that I have had some opportunity to study the effects of herbicides in Vietnam as chairman of the Herbicide Assessment Commission of the American Association for the Advancement of Science and I offer for insertion in the record our preliminary report.

The CHAIRMAN. Without objection, it is so ordered.

(The information referred to follows:)

PRELIMINARY REPORT, HERBICIDE ASSESSMENT COMMISSION OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

(Matthew S. Meselson, Professor of Biology, Harvard University, Cambridge, Mass.; Arthur H. Westing, Professor of Biology, Windham College, Putney, Vt.; John D. Constable, Professor of Surgery, Harvard Medical School, Bos-

ton, Mass.; Robert E. Cook, Department of Biology, Yale University, New Haven, Conn., Dec. 30, 1970)

INTRODUCTION

The Council and the Board of Directors of the AAAS have for several years sought to encourage scientific study of the effects of the large-scale military use of chemical herbicides on the ecology and on human welfare in South Vietnam. In December 1969 the AAAS Board appointed Matthew S. Meselson, Professor of Biology at Harvard University, to develop a plan for such a study, authorizing an expenditure of \$80,000 for the purpose. Meselson appointed Arthur H. Westing, Professor of Botany at Windham College in Vermont, to direct the Herbicide Assessment Commission, the title under which this AAAS activity is known.

In the first phase of its work the Commission reviewed the pertinent literature and solicited information and advice from numerous experts in the U.S., Vietnam and elsewhere. This was followed by a conference in June, which brought together twenty-three experts in various fields for an intensive week of study and planning.

During August and September of this year, Meselson and Westing, together with Dr. John D. Constable, Professor of Surgery at Harvard Medical School, and Mr. Robert E. Cook, graduate student in ecology at Yale University, conducted a study tour in South Vietnam. The purpose of the tour was to identify the chief problems and to determine facilities, methods, and locations most suitable for future studies. What follows is a preliminary report of their findings and recommendations. A detailed report will be published at a later date.

1. Mangrove forests.

Much of the coastal area of the Mekong Delta region is occupied by mangrove forests. As a rough approximation, half of these forests, some 1,400 square kilometers, have been sprayed with herbicides. For as yet undetermined reasons, mangrove species have proved to be particularly sensitive. Essentially all vegetation is killed. Preliminary aerial and ground inspection by the Commission showed little or no recolonization by mangrove tree species after three or more years. However there is scattered growth of the fern *Acrostichum aureum*, the shrub *Wedelia biflora*, and a few other species. Without vegetation, the area obviously cannot support most of the bird and ground animal species associated with the previously existing mangrove forests. A possibly important exception are crabs, large numbers of which were observed in barren areas. By devouring seedlings, crabs may be retarding revegetation. There are signs of erosion along the denuded coastlines but as yet they are slight. Major typhoons, which on the average strike the mangroves about every five years, have not occurred since herbicide was sprayed.

Studies aimed at reclamation of this land could be started immediately. Mangrove forests once provided a major source of fuel wood and charcoal. Mangroves also play an important role in providing food and nursing grounds for fish and crustaceans, although the magnitude of this contribution is not known. An attempt to estimate the impact that the permanent loss of mangrove forests would have on the fishing industry should be made before deciding how much of the former mangrove area should be replanted to tidal forests and how much devoted to other purposes. The urgency of replanting depends on the pace of erosion and soil deterioration and on the time scale of possible overgrowth of undesirable and hard to eradicate species such as *Acrostichum*. These time factors may well allow several years, but they could and should be studied immediately.

2. Tropical Hardwood Forests

Approximately one-fifth of South Vietnam's merchantable hardwood forests have been sprayed, including many of the oldest and most valuable stands. Aerial inspection of forests in a wide arc north of Saigon extending from the Cambodian frontier in the west to the South China Sea on the east showed more than half of the forest to be very severely damaged. Over large areas, most of the trees appeared dead and bamboo had spread over the ground. A danger in this is that the invading species may be essentially worthless and very expensive to eradicate. Bamboo will retard the reestablishment of forest trees, at least for many decades. A further hazard is that large amounts of nutrient minerals previously tied up in forest vegetation may have been released and leached out

of sprayed forests by the heavy tropical rains. Whether or not this process, which may be called nutrient dumping, has occurred on a scale large enough to seriously reduce soil fertility can be determined by relatively simple ground measurements. Intelligent planning of forestry policy, including reforestation, requires prompt attention to these and other possible herbicide effects. The true conditions of the forests including, but of course not restricted to the effects of herbicides, should be determined by aerial and ground inventory at the earliest possible date.

3. Contamination of Food Chains.

The Commission collected samples of shrimp, fish, human milk, and other materials for analysis for the presence of herbicides, their impurities, and their breakdown products. As yet, we are developing methods for the required analyses. Emphasis is being given to improved methods for the analysis of 2,3,7,8-tetrachlorodibenzodioxin. Dioxin, as this material is called, occurs as an impurity in Orange, the principal herbicide used in Vietnam. Its potential importance lies in the fact that it is exceedingly toxic, may be quite stable in the environment, and, being fat soluble, may be concentrated as it moves up the food chain into the human diet. Very rough model calculations suggest that it is not impossible that significant amounts of dioxin are entering the Vietnamese diet. This is certainly not to say that this is occurring, but it should not be very difficult to make an accurate study of the question. The main obstacle at present is the lack of sufficiently sensitive and reliable methods for the analysis of dioxin.

4. Health Effects.

A principal concern here has been the possibility of the induction of birth anomalies by 2,4,5-T, dioxin, or both. Such effects have been found in laboratory experiments with animals and led to an order last April stopping the use of agent Orange. The U.S. Army and the South Vietnamese Ministry of Health have recently published a survey of stillbirths, hydatiform moles (placental tumors), and malformations, based on South Vietnamese hospital records for the past ten years. A slight but encouraging downward trend is reported in all three categories. Unfortunately most of the data come from Saigon, which has, of course, not been treated with herbicides. Indeed, probably no more than five or ten percent of the South Vietnamese population has been directly sprayed and we have essentially no data on this group. They would be very underrepresented in Ministry of Health records. However, persons living outside of Saigon have been more heavily exposed to herbicides than those living in the Capital. This could occur not only by occasional direct exposure but also by exposure to drift and to herbicide residues in food and water. Upon subtracting the Saigon data, the Army study does, in fact, show a decided upward trend in stillbirths, moles, and deformities in the rest of the country. However, it would be totally incorrect to consider this as proof of an effect of herbicides. More complete recording and increased referral of difficult pregnancies from the countryside to the provincial hospitals could easily account for the observed trends. More thorough surveying in selected provinces might help to settle this question. Although the Commission could only study limited areas, we did evaluate in detail the birth records in Tay Ninh, a very heavily defoliated province. We found that for the years 1968 and 1969, the Tay Ninh provincial hospital showed a higher rate of stillbirth than any of those reported in the Army study.

Another approach would be to look for strikingly unusual deformities in heavily sprayed areas although the Commission found none reported within the Ministry of Health system. Still another type of survey would focus on the relative frequencies of each of several commonly identified malformations in hospitals conducting pediatric surgery. However, there is only one large hospital of this kind, because it is in Saigon, obvious limitations are imposed. Its records do show a disproportionate rise in 1967 and 1968 of two anomalies, cleft palate and spina bifida. It would be important to examine these trends more closely. Still, this could never prove a causative connection with herbicides. The survey approach offers little hope of proving or disproving any relation between herbicide exposure and the incidence of birth defects unless one can find sizeable groups of similar people living under similar conditions, one heavily exposed and the other not exposed. If such populations exist and can be studied, it would be worthwhile to survey children at various ages for anomalies.

It may well be that we can learn more about this subject from the indirect approach of determining the amounts of herbicide residues in the diet and in hu-

man tissue, waiting for future research to determine the implications, if any, of whatever levels are found.

5. Crop Destruction

Some 2,000 square kilometers of land in South Vietnam have been sprayed in order to destroy food crops. It has been authoritatively estimated that this entailed the destruction of enough food to feed approximately 600,000 persons for a year. Our observations in Vietnam lead us to believe that precautions to avoid destroying the crops of indigenous civilian populations have been a failure and that nearly all of the food destroyed would actually have been consumed by such populations. Even so, if the affected civilians were distributed throughout the country or if they lived in food surplus areas, the impact would be small compared to other hardships, since the food destroyed amounts to less than two percent of the national crop in any one year. However, anticrop spraying has been largely confined to the food-scarce Central Highlands, the entire population of which is only about one million. Most of these are Montagnards, tribal peoples racially and linguistically distinct from the lowland Vietnamese. These peoples are animists, closely tied to their land by tradition and religious belief. We believe the anti-crop program may have had a profound impact on a large fraction of the total Montagnard population of South Vietnam and we believe this to be a point for urgent consideration. As for retrospective studies, these could best be done by one or more of several highly respected anthropologists who have spent many years studying and living among the Montagnards.

6. Military Considerations.

It should be made clear that the studies undertaken and recommended by the Herbicide Assessment Commission are after the fact and without reference to the military utility or desirability of the use of herbicides. Although these are certainly matters that could be subjected to study and evaluation, this would be completely outside the assignment given the Commission by the AAAS.

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE,
AAAS HERBICIDE ASSESSMENT COMMISSION,
Cambridge, Mass., November 12, 1970.

HON. ELLSWORTH BUNKER,
American Ambassador,
Saigon, Republic of Vietnam,
APO San Francisco, Calif.

DEAR AMBASSADOR BUNKER: On behalf of the Herbicide Assessment Commission of the American Association for the Advancement of Science, we wish to express our appreciation for the generous assistance provided by the Embassy during our recent tour of the Republic of Vietnam.

We are now preparing our report for presentation to the AAAS at the end of December and will send a copy to you as soon as it is available. Before that time, however, we wish to relay some observations that we believe merit your more immediate attention because they challenge the basis of the current chemical crop destruction program.

On August 21 and 28 we overflew an area in Quang Ngai province where chemical crop destruction operations had been conducted a few days before. The responsible chemical operations staff officer accompanied us on one of the overflights, and we spoke at length with other officers and civilian officials on the scene. It was explained to us that the targets were VC/NVA crop production areas and that most of the food destroyed would otherwise have been consumed by enemy forces. The reasons given for this assessment were that—

1. The target area had only a very low population density.
2. The area under cultivation had expanded strikingly in recent years.
3. The cultivated area was much larger than that needed to support the small indigenous population.
4. The existence of numerous terraced rice fields indicated the influx of VC/NVA food production units, since the Montagnards who comprise the native population do not practice terracing.

Our observations are sharply at variance with all four of these points.

Background information.—One of the target areas is shown in photograph 1. Three C123 aircraft sprayed herbicides along the Song Re river valley from map

coordinates BS 3455 to BS 3543. The photograph was taken near the latter coordinate, looking northward up the valley. The spray swaths are generally visible as brown streaks. Spraying was conducted continuously for a distance of about ten miles, resulting in coverage of approximately 1000 acres. Photographs 2 and 3 show the ground more closely. Numerous craters have been caused by the preparatory laying down of maximum suppressive fire, including the application of 300 per cent saturation with cluster bomb units, a measure required by the Seventh Airforce to protect the low-flying C123's against hostile ground fire. Many dwellings may be seen in both close-ups, especially in photograph 3. The site of each of the photographs is indicated on the accompanying 1:50,000 scale U.S. Army map.

Population density.—The map shows a high population density throughout the target area. In the twenty-seven 1 km² grid boxes through which the spraying passed, there are more than 900 dwellings, indicated as small black squares. Detailed comparison of the map with photographs 2 and 3 suggests that the number of dwellings in the target area is at least as great as it was in 1965, the year in which the map was last revised. Assuming, for example, an occupancy of six persons per dwelling, the population in the sprayed area would be approximately 5,000. This corresponds to 180 persons per square kilometer, hardly a low population density.

Expansion of cultivated area.—The boundaries of cultivated fields on the enclosed map (and also on a matching 1:20,000 scale pletomap) agree well with the boundaries seen in our photographs, offering no evidence for any major expansion of crop production since 1965. Also, the fields seen in the photographs look well established and not of recent origin.

The question of surplus.—The amount of land under cultivation in the target area may be estimated from the map to be approximately 800 hectares, about one hectare for each dwelling. Contrary to the view that a large surplus of food was being grown in the valley, one hectare of mountain land is just about enough to sustain a family unit.

Significance of terraced fields.—Authoritative DoD publications on the Montagnard peoples as well as knowledgeable officials in Saigon state that the Montagnards of Quang Ngai, the Hre, have long grown rice on terraced fields.

We realize that this particular crop destruction mission may have been atypical. However, it was cited by the chemical staff officer and other officials as being particularly effective and well planned.

Moreover, our observations lend additional weight to several official studies done in Vietnam which have concluded that nearly all of the food destroyed by the chemical crop destruction program would normally be consumed by civilians, not by enemy soldiers.

As to the scale of the present crop destruction program, we were distressed by the implications of an analysis prepared by the GVN at the province level estimating the quantity of rice and other crops marked for chemical destruction under the 1970-71 herbicide program. Including missions requested by U.S. elements as well as those requested by the Vietnamese themselves, the total quantity of food scheduled for destruction is placed at 14,575 metric tons in Quang Ngai and Quang Tin provinces alone. This should be enough to sustain some 50-70,000 persons for a year. The targets are located mainly in upland regions where Montagnards are the traditional population. The Special Commission for Highland Affairs estimates the total Montagnard population of the two provinces as just under 70,000. Therefore if the areas we inspected are any indicator, the destruction of so much food or even of any substantial fraction of it would have devastating consequences for the Montagnard peoples of Quang Ngai and Quang Tin and for indigenous peoples in other provinces where similar conditions may prevail.

While we were in Quang Ngai province we had several occasions to interview Montagnard refugees whose lands had recently been sprayed with herbicide. We were impressed with the way in which they perceive the use of the chemicals. Apparently when the land is effected by herbicides, the Hre people consider it to be the manifestation of an evil spirit, and according to their tradition will abandon such land in the belief that it has fallen under a curse. Thus the folk beliefs of the Hre may intensify the effects of the crop destruction program on their lives.

Before leaving Vietnam we made a preliminary report of our observations to General Abrams and to Mr. Stephen Winship and Mr. Terence Grant of the Embassy Political Military section. Upon our return, one of us was requested to

present a briefing at the State Department in Washington. The briefing took place on October 19 before a working level group consisting mainly of personnel from the Bureau of East Asian and Pacific Affairs and the Bureau of Intelligence and Research. We are also sending copies of this report to Secretary Rogers and to General Abrams.

We strongly hope that our observations can make a positive contribution toward bringing under review a program which seems to us very much in need of it.

Sincerely yours,

MATTHEW MESELSON.
JOHN CONSTABLE.

Dr. MESELSON. To return to the question of riot-control agents, we must decide whether the military gain from maintaining a first-use option for riot gas is likely to outweigh the benefits of reinforcing the barriers against the use of all gas by others. Let me start by summarizing my conclusions.

TERMINOLOGY CONCERNING GASES

The CHAIRMAN. Could I ask you a question about this terminology? I have great difficulty in dealing with these terms.

How is riot gas distinguishable from a nonlethal gas or a harassing agent or incapacitant? I have great difficulty. Everybody shifts a little bit in the use of these terms. "Riot" seems to me to be a poor way to describe a gas. It is the use for which you employ a gas. It may or may not be lethal; may it not? I mean it has nothing to do with its inherent characteristics. It is the use for which you employ it. Is it not feasible to use a term which we could all accept as being more closely related to the character of the gas, rather than the use to which it is put?

Dr. MESELSON. Yes, there is difficulty there, and I certainly agree with what Dr. Brennan was saying; there is a continuum.

One attempt to try to distinguish what is meant by riot gases is to say these are gases whose effect lasts not much more than a few minutes longer than the period of exposure.

The CHAIRMAN. Would not nonlethal, that is one that does not permanently injure the person, be closest to the concept we are trying to get at?

Dr. MESELSON. When the President renounced any first use of incapacitating chemical weapons, I believe that included all nonlethal chemicals whose effect would last for more than a few minutes. But the distinction is not altogether clear cut.

The CHAIRMAN. It seems to me at least, the word "incapacitating" is more significant than the use of the word "riot." It relates to the effect upon the person rather than the use to which you want to put it. That always seemed to me to be an unsatisfactory term, but I would hope that we could get a rather universal agreement as to what we are talking about. You use the term, I take it, to mean a gas that has a very temporary effect upon the object; is that not correct?

Dr. MESELSON. Yes, when not used in excessive dose.

The CHAIRMAN. Mr. Nutter, I may say, said the other day that riot-control agents would include the fact that these are agents that are used normally by civil authorities in law-enforcement activities. He was using again though the purpose for which you use the gas, which seems to be a criterion. But proceed, Doctor.

SUMMARY OF CONCLUSIONS

Dr. MESELSON. Summarizing my conclusions in advance, they are three.

First, the military value of riot gas to the United States is very low.

Second, our overriding security interest in the area of chemical and biological weapons is to prevent the proliferation and use of biological and lethal chemical weapons.

Third, our use of riot gas in war runs directly counter to this fundamental interest.

CS AND ITS USE

The only riot gas now provided to our forces is CS. It was developed by the British in the 1950's as a more potent agent than ordinary tear gas for dispersing rioters. It is a white solid which can be disseminated in the air as a fine powder or smoke. Exposure to CS causes intense pain in the eyes and upper respiratory tract, progressing to the deep recesses of the lungs where it causes a feeling of suffocation and acute anxiety. Other symptoms include nausea, vomiting, and under humid conditions, irritation of the skin. If exposure is not too intense, the symptoms pass away soon after restoration to fresh air. When used with proper precautions, CS is a relatively safe agent for riot control because there is a large difference between the amount needed to cause brief incapacitation and the amount that causes serious injury or death. When used in combat, where many of the currently employed CS weapons contain much more of the agent than do police-type munitions, CS can cause severe blisters and skin burns that take 1 or 2 weeks to heal. Although extreme exposures in some combat situations may even exceed the human lethal dosage, the primary effect of CS is not to kill but to incapacitate.

Protection against the ocular and respiratory effects of CS is readily provided by a gas mask. Skin covered with ordinary clothing is fairly well protected against blistering and special ointments have been developed for additional skin protection.

The response of unprotected personnel to CS is influenced by their motivation and training. Troops exposed to CS for the first time, or who are poorly disciplined, often abandon their positions in an attempt to escape the gas. Experienced troops are less likely to leave their positions, but their fighting efficiency will be much reduced. Unprotected troops attacking through a cloud of CS are likely to falter.

In the past 5 years, a wide variety of CS weapons for air and ground delivery has been developed and deployed in Vietnam. These include grenades, blowers, mortar cartridges, artillery projectiles, rockets, and several types of aircraft bombs. These have been used in a number of defensive and offensive roles, including the following:

DEFENSIVE USES OF CS WEAPONS

1. Perimeter defense, in conjunction with other weapons, to disrupt infantry attacks on outposts and other fortified areas.
2. Extraction of downed helicopter crews, by rescue helicopters performing fire-suppression missions with CS and high-explosive fire.

OFFENSIVE USES OF CS WEAPONS

1. Flushing enemy troops from cover in conjunction with anti-personnel artillery and air strikes.

2. Reconnaissance by fire, using CS to force concealed troops to reveal their location in the course of attempting to flee the agent cloud.

3. Flushing tunnels and other shelters in the conduct of patrols and infantry sweeps.

A great deal of CS has also been used with the intention of denying terrain and installations to the enemy. For this purpose a special moisture-resistant modification of CS has been developed, and is designated CS-2. For several weeks after the application of CS-2, the movement of vehicles or personnel will reintroduce the agent into the air, causing significant harassment.

DIFFICULTY OF EVALUATING MILITARY UTILITY OF CS

An attempt to evaluate the military utility of CS immediately runs into severe difficulties. As Secretary Rogers announced earlier in these hearings, the administration has recently initiated a systematic field study of this question. At present we have only very limited information, based largely on unstructured interviews with officers and troops. Evaluation is complicated first of all by the fact that CS is almost never used by itself. It is a supplemental weapon, used in conjunction with other weapons. In other words, when CS is used, a great deal more is also going on and it will not be simple to disentangle the many variables. Second, and probably more important, the utility of CS, like that of any gas, depends to an extraordinary degree on whether the enemy is trained and equipped to defend himself.

DECREASING MILITARY UTILITY OF CS

My own impression of the value of CS is based on field interviews done by others in 1968, and numerous conversations I have had with officers and troops in Vietnam and in the United States during the past year. What emerges is that a few years ago the weapon was favorably regarded by most of those who had actually used it, but that today it is used much less and is not highly valued. One artillery commander in the Delta told me that he had simply stopped using CS, while another used it only rarely and thought it of only marginal value. Flying perhaps a dozen gunships and other helicopters, I never once found CS to be on board; nor was it stocked at either of the two isolated fire bases I visited. Questioning of 30 men with combat experience revealed only two who had ever seen CS used, and then on only one occasion each. A highly experienced Air Force commander thought CS was desirable to have on hand as an aid to fire suppression during rescue of downed helicopter crews, but estimated that it was used for this purpose in fewer than one out of 50 rescues. A high-ranking officer in the Cambodian operation last year considered CS to be of very little importance.

A major factor in the decreasing utility of CS is probably to be found in the response of the enemy. In 1968, a large proportion of

North Vietnamese troops in the northern provinces of South Vietnam had Chinese gas masks, but the VC were still not well-supplied, especially in the South. In contrast, last year, according to an Army commander in one of the Delta provinces, nearly all of the VC troops killed in action were found to carry Chinese gas masks if their bodies had not been previously stripped of weapons.

I have here, Mr. Chairman, a Chinese gas mask picked up in South Vietnam. It is a reasonably sophisticated two-piece mask, rather small. This is the filter on it. In Chinese it says "Poison gas filter, model No. 66." It also has some designation that appears to mean that it was inspected in 1967. These are the goggles that go with it. It has a charcoal filter in the base, and I have tested it and it provides protection against CS. It may be that it would provide protection also against nerve gas. This kind of mask which is easily carried, small, lightweight, apparently now is so widely distributed in Vietnam that the utility of CS gas has plummeted drastically as a result.

To summarize regarding the utility of CS, it seems to have been a useful auxiliary weapon in certain situations when it was first introduced. However, its use and its utility have greatly declined, because the enemy has learned to cope with it, especially by equipping his troops with gas masks. Indeed, on numerous occasions he has used CS on a limited scale against us.

IMPLICATION FOR THE FUTURE

The implication for the future is clear: If we continue to use CS in warfare, we cause other nations' military forces to examine their defenses. This will stimulate them to procure gas masks and gas weapons of their own. Consequently, fewer adversaries and potential adversaries will remain unprotected and unable to retaliate—and the utility of CS to us will decrease proportionately. Still, this in itself is no reason to renounce the first use of riot gas in war. Rather, it furnishes perspective as we inquire into the security benefits of renouncing such first use.

IMPRESSION THAT RIOT GAS MAKES WAR MORE HUMANE

But first, it is important to correct a commonly held impression that the use of riot gas makes war more humane. Although the initial use of CS in 1965 was widely seen as a means to separate civilians and soldiers and thereby save civilian lives, in actuality CS has seldom been used for this purpose. A field study conducted in 1968 concludes that this is partly because mixed groups of enemy soldiers and civilians are rarely encountered. The study noted that in the Americal Division area of operation there had been only one known case in which CS was used primarily because of its nonlethal character. When civilians have reason to expect a fire fight to break out, they either try to flee or take cover. Paradoxically, even in those rare cases when soldiers and civilians are intermingled, CS can actually increase the casualties to civilians by forcing them from cover into the line of fire where they know less well than do soldiers how to take care of themselves.

Neither is CS often used to make war more humane for the other side. Occasionally, the use of riot gas to flush a tunnel has led to the capture of enemy soldiers who otherwise might have escaped or been killed. But these very limited occurrences are greatly overbalanced by the use of CS to enhance the lethal effectiveness of conventional fire power. Indeed, this should come as no surprise. Tear gas was used in World War I, in Manchuria, in Ethiopia, and in Yemen—but not to make those wars more humane. It is unrealistic to expect a soldier to refrain from using the lethal weapons which he has available when doing so may save his life. Troop morale would surely plummet if officers issued any such unrealistic orders.

RESTRAINTS AGAINST CHEMICAL AND BIOLOGICAL WARFARE IN PAST

Now I would like to discuss the factors which I believe have tended to discourage the use of chemical weapons in the past 45 years.

There have been several factors which have operated to discourage nations from initiating chemical warfare and even from making preparations for waging it. Public opinion has regarded chemical warfare as particularly uncivilized and repugnant, an attitude that has been shared by not a few political and military leaders. At the top levels of military planning, chemical weapons have enjoyed little attention or support in comparison with other types of weapons. In the past, most armies have been unprepared to use chemicals. Even when the weapons have been procured and stockpiled, they have been poorly integrated into combat forces and war plans.

The few nations which possess chemical weapons have tended to regard them much more as a deterrent against the initiation of chemical warfare by the enemy than as dependable war-fighting instruments. Reluctance to accommodate to the costs and complexities of the chemical battlefield and fear of retaliation and escalation have reduced the incentive to initiate chemical warfare.

Thus, psychological aversion, military disinterest, inadequate preparedness, and fear of retaliation have all acted and interacted to form a complex of restraints preventing chemical warfare. In the same category, and in many ways not clearly distinguished, is the use of germs in war—biological warfare. The traditional restraints against chemical and biological warfare are embodied in one of the oldest arms control treaties now in force, the Geneva Protocol of 1925. Its prohibition of chemical and biological warfare under international law adds to the moral and political forces of restraint.

In addition, the protocol places gas and germs in a distinct category, offering a clear and explicit standard upon which nations can base their conduct.

RISKS OF PROLIFERATION OF LETHAL CHEMICAL WEAPONS

Now I would like to turn to what the implications of the use of lethal gas would be for the security of the United States.

In the context of both tactical and strategic war, it is very much in the United States' interest to preserve and strengthen the restraints that prevent chemical warfare and the proliferation of chemical weapons. Today, so-called limited wars are fought with conventional

weapons which individually affect only a small area. Such weapons can be decisive only when very great quantities are available. The wealth of the United States allows us to expend enormous quantities of conventional munitions in tactical combat. Very few countries even approach this capability. However, the proliferation of lethal chemical weapons would greatly enhance the destructive capability of smaller and less wealthy nations. This is because, as Dr. Brennan pointed out, chemical weapons have the potential of large area coverage at relatively low cost. Many of the types of munitions used in limited war can be filled with lethal chemicals instead of explosives. The "kill area" of lightweight munitions such as mortar cartridges and rockets would thereby be increased by a large factor.

Modern lethal gas weapons can be made by many countries. They can be supplied to small nations and even to dissident forces by their big power allies. Even though defending troops can be provided with protective masks and suits, such weapons would be devastating to military units caught off-guard and to the civilian population. In many situations lethal chemical weapons would favor guerilla forces. Such forces generally have no shortage of targets. They know the locations of military installations such as base camps and support facilities. Their problem is their great inferiority in firepower. For antiguerilla forces the reverse is usually true, their main tactical problem being location of the enemy. In this situation any major enhancement of the area coverage of lightweight weapons disproportionately favors less sophisticated forces operating in smaller units capable of dispersing over large areas or mingling with the civilian population. Moreover, the proliferation of lethal chemical weapons would create greatly expanded opportunities for terror attacks on urban centers by small groups of men firing chemical rockets or mortars from the outskirts. Thus, the proliferation of chemical weapons would seriously reduce the military advantage that great wealth confers, while at the same time threatening a major increase in the violence of war and its toll among civilians.

At the strategic level, the hazard of proliferation of lethal gas weapons is also serious. Countries not possessing nuclear weapons might be tempted to acquire a population killing capability based on nerve gas. Under suitably chosen meteorological conditions, a small bomber force could deliver enough nerve agent to kill a large proportion of persons in a major city. Although it is unlikely that a poor nation could successfully deliver chemicals over a wide area of a country with modern air defenses, it would be difficult to defend against a surprise attack on one or a few coastal cities. Further, it should be noted that the proliferation of chemical weapons is likely to stimulate interest in the strategic possibilities of biological weapons and that the economics of antipersonnel and anticrop biological weapons for threat or deterrence may come to seem particularly attractive to less wealthy nations.

To summarize, the proliferation of lethal chemical weapons would risk a major increase in the level of death and devastation in wars of all kinds. Proliferation would provide forces less wealthy and sophisticated than the United States with greatly enhanced capability for threat, harassment, and destruction. The acquisition of chemical weapons would stimulate interest in biological weapons, for the barriers against both are intertwined. The overriding objective of the United

States in this area of policy should be to prevent the proliferation of chemical and biological weapons and to strengthen the barriers against their use.

RIOT GAS AND PROLIFERATION

Now we come to the question of what all this has to do with the use of riot gas in war.

The example of the world's most modern army using gas for the first time in 45 years and deploying a whole panoply of newly developed gas munitions cannot help but stimulate the interest of foreign military establishments in the utility of similar weapons. Military planners in other countries would be remiss in their duty if they did not carefully study the use of riot gas in Vietnam. If we retain our first-use option for this weapon, others must give more serious attention to analysis and planning for chemical defense and chemical warfare for, after all, they may be the ones to encounter it in the future. At a minimum they will be motivated to procure gas masks and intensify chemical training. Having done this, the additional cost of acquiring a lethal chemical capability is reduced. As more armies become accustomed to training in a chemical environment, as chemical cadres are upgraded and careers become dependent on a role for gas, the next step leading to acquisition of lethal chemicals becomes smaller and harder to resist. Many of the techniques for the dispersal of riot gas are similar to those employed for lethal chemicals, so that the progression to an offensive lethal capability would be facilitated.

Here, for example, Mr. Chairman, is U.S. 155 millimeter riot gas artillery shell developed for use in Vietnam. It has a maximum range of about 9 miles. Using weapons like this would accustom military establishments for foreign countries to techniques closely allied to the techniques they would need to use lethal gas.

Thus, over time, the consequences of the use of riot gas in war will cause nations less wealthy than ours to take more seriously the possibilities of lethal gas for deterrence, threat, and harassment.

DANGER OF ESCALATION ON THE BATTLEFIELD

If the proliferation of lethal chemical warfare readiness—and that is what I believe to be the principal hazard, proliferation of readiness for lethal chemical warfare—if this should get under way, escalation on the battlefield becomes a very real danger. Having become accustomed to the use of riot gas, other nations may be less inhibited than the United States has been in progressing on to lethal chemicals. The experience in Yemen where riot gas was used before poison gas appears to be an example of such escalation. Indeed, the use of riot gas apparently preceded the escalation to lethal agents in every case where lethal agents have been used—in Manchuria, in Ethiopia, and in Europe during World War I.

The use of harassing gas paves the way by providing experience and establishing defensive preparations and logistic arrangements that can facilitate the transition to other, more toxic gases. Once the other side deploys gas masks, riot gas loses almost all of its effectiveness. An obvious response in that case would be to employ skin irritants, which could include relatively subtle modifications of existing riot agents.

For example, here is an Army study of the effect of CS gas on human skin. ("The Effects of Thermally-Generated CS Aerosols on Human Skin," Edgewood Arsenal Technical Report No. 4075, January 1967, AD 809-185.) In this photograph four volunteers have placed their arms in a chamber containing humid air and CS gas. After 10 minutes exposure to high concentrations of the gas, serious blisters developed. This only happens in humid air, but it does happen in the field quite commonly in the presence of humid air and high concentrations of the gas.

Another country, finding their riot gas not to be so effective after gas masks have been deployed, might find that there are otherwise harmless chemicals that could be added to their riot gas to make it act on the skin even in dry air.

The move to more toxic skin agents such as mustard gas may not seem as great as the step of introducing harassing agents in the first place. Another source of pressure to move upward in the scale of toxic weapons could be born of desperation to retrieve a deteriorating battlefield situation where defeat would have serious political repercussions.

Even if both sides in a conflict were to tacitly agree to limit themselves to nonlethal agents, there may be serious difficulty in finding a mutually agreeable and workable standard, particularly as the steady advance of technology generates more agents and combinations of agents with novel effects.

RIOT GAS AND THE GENEVA PROTOCOL

In December 1969, the United Nations General Assembly by a vote of 80 to 3, with 36 abstentions, adopted a resolution holding that the Geneva protocol prohibits the use in war of all toxic chemicals against man, animals, or plants. It was made clear in the debate that agents like CS were included within the meaning of the resolution. The three negative votes were cast by the United States, Australia, and Portugal. In view of the U.N. resolution, there appears little likelihood of securing widespread agreement to exempt riot gas from the protocol. However, if we were to relinquish our first-use option for this weapon, as we have already done for all other gases, we could almost certainly obtain overwhelming international agreement on the applicability of the protocol to all antipersonnel chemicals, without exception.

The cost of continued division regarding the scope of the protocol is to weaken its political and psychological effectiveness and to block progress toward more far-reaching agreements to prevent the proliferation and use of both chemical and biological weapons.

WHAT POLICY FOR RIOT GAS?

What policy should we have in view of all this for riot gas?

The utility of our option to use riot gas in combat has to be weighed against the costs it imposes by stimulating the proliferation of chemical warfare capability generally and by perpetuating international disagreement regarding the meaning of the Geneva protocol. When it was relatively new to the battlefield, riot gas was in certain situations a useful adjunct to other weapons in Vietnam. But now its value has decreased to a low level, chiefly because the enemy has acquired

gas masks and learned to cope with gas tactics. If we continue to use CS and to integrate it into our combat forces, fewer of our present and potential adversaries will remain unequipped with gas masks and gas weapons. As this happens, the utility of CS to us will decrease proportionately. In contrast, our interest in preventing the proliferation of chemical weapons will continue and intensify with the increasing capability of more nations to produce modern weapons once considered accessible only to the most technologically advanced countries. It would appear, therefore, that our long-term interest is to repair to the traditional standard of not using gas weapons of any kind in war. If this is so, we should attempt to ratify the Geneva Protocol in a manner that will allow us to support a broad interpretation of its scope to which all nations can agree.

COMMENDATION OF THE WITNESS

The CHAIRMAN. Thank you, Dr. Meselson. That is a very perceptive and a very searching analysis. The similarity of some of your arguments to those of Dr. Brennan on this subject, especially relating to the advantage or disadvantage that a large and industrially advanced country would suffer from the proliferation of these relatively cheap weapons is right remarkable.

I think it is a very persuasive argument.

SUGGESTED DELAY IN RATIFICATION

Do you have any suggestions to make about strategy that we were talking about a moment ago, that rather than ratify with a limiting understanding, to allow it to perhaps germinate a little while longer while the developments in war become more clear and the study by the administration is completed?

Do you have any comments to make on that?

Dr. MESELSON. I feel the essential problem here is that, understandably enough, our perceptions are still strongly affected by what has happened in the past, but that our interests for the future are quite different. Therefore, I think that we need some kind of separation so that our long-term interests can be seen more clearly.

The CHAIRMAN. Do you have any questions at this time?

BRITISH RATIFICATION OF PROTOCOL

Senator AIKEN. I know you CS was developed by the British. The British, I believe, have approved the protocol without reservation.

Dr. MESELSON. Great Britain ratified the protocol in 1930. However, last year the Labor government made a special exception for CS gas, saying that in their opinion CS was not prohibited by the protocol. This decision by the Labor government was almost universally denounced in the British press, and the British representative, Lord Chalfont, who defended this exemption of CS at the General Conference of the Committee on Disarmament, wrote a very strong attack on it after the Labor government left office. I understand the matter has been under review by the present Conservative government. I do not know what their attitude is.

I believe that the Labor Cabinet allowed immediate events to cloud their perception of their true interests. They were using CS gas in Ulster and they fell into the trap of confusing the police use of tear gas, which is in no way prohibited by the Geneva Protocol, with the military use in warfare which, in the opinion of the majority of nations, is prohibited.

Indeed, checking for only one year, 1969, in the New York Times Index, one finds that Argentina, India, Pakistan, and Sweden, four co-sponsors of the U.N. resolution, all used tear gas for police purposes, even though they hold it to be prohibited in war.

It is important to remember that from the end of World War I until 1965 in Vietnam, the United States never used tear gas in warfare even though it was employed routinely by American police throughout that long period. I think the British were temporarily confused because they had never used tear gas domestically until Ulster came along. The story told by Lord Chalfont in an article in the New Statesmen magazine is that the issue of the status of CS under the protocol came up only because the Minister for Disarmament, Mr. Fredrick Mulley, wanted the Government to go on record as reaffirming the principle that all tear gas was prohibited. That threw it open to discussion within the Cabinet and, much to the surprise and dismay of Mr. Mulley, the Cabinet went the other way because of the influence of the events in Ulster.

IS UNITED STATES DELIVERING GAS OR HERBICIDES?

Senator AIKEN. Do you know whether the United States is delivering any gas or herbicides as part of our military assistance programs to smaller nations?

Dr. MESELSON. I do not know, Senator.

I know that whether or not the Government of Vietnam forces require herbicides is a problem that has been under study within our Government, but I do not know if there has been a resolution of that question.

Senator AIKEN. That is all.

POSSIBILITY OF LOSING MOMENTUM BY DELAYING SENATE ACTION

The CHAIRMAN. As you so well have said in your original statement, the administration has already taken a number of commendable steps to limit chemical and biological weapons. As one who apparently approves of these actions, are you not concerned that delay in Senate action on the protocol would result in the loss of momentum within the Government on steps to limit chemical and biological weapons programs?

Dr. MESELSON. Senator, I think because so many other nations have ratified the protocol, because the world inevitably is going to become more concerned with environmental questions and with arms control, and because it is in our best interest to ratify, I do not see much danger that in time the United States will not become party to this treaty.

I think a greater danger would be if we were to bring it up and have it defeated because of disagreement and confusion caused by the

events of the recent past. I think we have to reduce that confusion by allowing some time to go by.

BETTER TO RATIFY WITH UNDERSTANDING OR DELAY?

Senator AIKEN. While it is not your primary responsibility to make these decisions on maneuvering, as we discussed with the previous witness, I wonder if you have a view about this question of whether it is better to ratify the protocol with the understanding that these nonlethal gases and herbicides are not prohibited—in other words, to accept the interpretation of the President. Would it be better to go ahead and ratify it or would it be better if we suspend action for a while pending the resolution of that question?

Dr. MESELSON. I fail to understand why we would want to ratify with an understanding that was against our own best interests, first of all. This seems to me to be the central point. It is foolish for us to want an understanding that can only accelerate the frittering away of restraints that benefit us.

I just do not understand why we would want to do that. But if the question is put, would you not rather have half a loaf than no loaf, no, I do not think so. I think that our ratification should have a significant psychological impact. We have never used poison gas. I do not think we have to sign on the line to be sure that the United States does not introduce poison gas. It is the proliferation of that kind of weapon to other countries that concerns me, and I think that the practice of the United States is the important question.

If, at the time we ratify, we are actually using riot gas in Vietnam, I think it is going to be very difficult for us to dissuade military establishments in other countries from devoting resources, and interest to chemical analysis and chemical planning, and I think that is what we have to avoid.

In contrast, if there is some signal that all use of gas by the United States is going to cease, then the allocation of resources, and the process of attracting attention of people in other countries to the opportunities and utility of lethal chemical warfare are likely to be dampened.

So I fail to see why we should make a move which is against our own best interests.

Senator AIKEN. You made your position very clear to the substantive question that it is not in our interest to preserve the use of these gases and herbicides. I was going on the assumption that since the administration feels that it does not wish at this time, at least, to exclude their use, is it better to wait a while than go on and move with their interpretation. This is a judgment, I agree, that has to be made here.

You are very aware of the attitude of people generally because you have been studying this field. I guess I was trying to get your evaluation of the impact upon these other countries if we proceeded to ratify with the understanding that herbicides and nonlethal gases are not included.

Dr. MESELSON. I think the impact would be detrimental. I think it is far better to delay.

Senator AIKEN. To delay. That is what I wanted to find out.

USE AND EFFECT OF HERBICIDES IN VIETNAM

Your statement deals almost entirely with tear gas, and you at one point stated you were at the moment laying aside the question of herbicides. Yet I think you headed the Herbicide Assessment Commission that visited Vietnam last year; did you not?

Dr. MESELSON. Yes, Senator.

Senator AIKEN. Would you mind telling us anything you care to about your impressions of the use of herbicides and what effect it had?

Dr. MESELSON. I should emphasize that our study was only a preliminary one. The American Association for the Advancement of Science gave us \$80,000 to examine the effects of the use of herbicides and to design a long-term investigation of these effects. We began with extensive consultations in the United States with experts from various Government agencies, from industry, and from universities. Then we went to Vietnam for August and part of September with the support of the Government of South Vietnam and the U.S. mission. We spoke with numerous Vietnamese scientists and officials and went into the field to investigate some of the areas where herbicide spraying had taken place.

I believe we were the first team of biologists to go in on the ground in some of the sprayed mangrove forest areas. We prepared a preliminary report which I offer for the record. I think it may be of some interest, if you wish, to show you some of the photographs we took in Vietnam.

Senator AIKEN. Did you say you prepared a report that is for the executive branch?

Dr. MESELSON. We prepared a report for the American Association for the Advancement of Science, which had commissioned our investigation and a separate report on the crop destruction program for Ambassador Bunker and General Abrams.

Senator AIKEN. Do you have them for submission to our record?

Dr. MESELSON. Yes.

Senator AIKEN. We will be very glad to have them. (See pp. 354 and 357.)

Dr. MESELSON. We did, of course, make our findings available also to the executive branch in Washington upon our return.

Senator AIKEN. What was their response, if you can tell us?

Dr. MESELSON. I think the response was one of considerable interest. I spoke with General Abrams, just before I left, for an hour and a half. We spoke with Ambassador Bunker when we arrived and corresponded with him. We corresponded with some embassy officials who indicated that the report we had privately sent them would be helpful because they were conducting a review of the herbicide program at the time.

Senator AIKEN. I would be very interested in your comments.

You say you have pictures?

Dr. MESELSON. Yes. I could direct my comments to them.

Senator AIKEN. All right.

Dr. MESELSON. This is a map of South Vietnam which shows approximately the areas intensively treated with herbicides since 1962 when the herbicide program began. These stippled areas are the principal areas where herbicides have been applied.

There are other targets, numerous small targets, which would be too small to show up here. Altogether about a seventh of the surface area of the country has been treated with herbicides.

Senator AIKEN. Approximately how many square miles is that?

Dr. MESELSON. It is approximately 6 million acres. That is about 9,000 square miles. It is approximately the size of the State of Massachusetts.

EFFECT OF HERBICIDES ON MANGROVE FORESTS

Several different types of land have been treated. This is a mangrove forest growing on the coast of South Vietnam about 30 miles south-east of Saigon. This forest has never been sprayed.

Here is a photograph of a region nearby that was last treated with herbicides about 3 years before the photograph was taken. There are a few surviving trees here at the top. It was a surprise that these particular chemicals—Agent Orange was used here—killed nearly all the vegetation in this type of forest. Agent Orange does not do that in upland forests, but for some reason we do not understand, mangrove forests are very sensitive to the herbicide used here.

Senator AIKEN. May I see that one a little closer? How long do you say this was after the treatment?

Dr. MESELSON. This was 3 years after the treatment.

A second problem that has not been solved is why, so long after the use of the herbicides in the mangrove areas, there seems to be almost no vegetation at all.

This photograph at ground level is typical of areas through which we walked at several locations that had been sprayed 3 years earlier.

Senator AIKEN. Were they just sprayed once?

Dr. MESELSON. They may have been sprayed more than once, but once is enough to kill all the trees.

This photograph shows an area that was sprayed just once. This is a much higher altitude photograph and shows a much bigger area. You can see there is a very sharp edge between the green forest which was not sprayed and the area which was sprayed and where the forest has been completely killed.

Senator AIKEN. Is that a mangrove forest?

Dr. MESELSON. Yes, a mangrove forest along the Ca Mao Peninsula. About 300,000 acres, half of the mangrove forest of South Vietnam, have been sprayed with herbicides. Just what this will cost in the long run to South Vietnam really cannot be said with assurance.

Mangrove forests provide food and sheltering grounds for fish and crustaceans, but we do not know the quantitative aspects of this problem. It could be that the impact on the South Vietnamese fisheries will be great. It could be that the impact will not be great. We just do not know enough about this kind of ecological system yet.

That is of interest even in our country. We need to know how valuable the Florida mangroves are, for example.

If it turns out that the role of mangroves in supplying fisheries is very important, then mangrove forests should be replaced in Vietnam. If it is not so important, then other things should be planted there. Something should be planted because the land is beginning to erode. The erosion is not serious yet, but neither has there been a major storm in that part of South Vietnam for 5 years.

Senator AIKEN. At the time of the spraying, was the foliage of the mangroves matured or was it in a period of new growth?

Dr. MESELSON. Much of it was more or less climax mangrove. In Vietnam and in Malaya mangrove is farmed. Usually there is about a 40-year period between cuts. The wood gives a very fine charcoal which is called high sheen charcoal because it is shiny, and it was extensively exploited for charcoal. Parts of this forest had been recently cut down, but most of it had not.

Senator AIKEN. No; but I mean the new growth of the foliage, not the tree.

Dr. MESELSON. Mangroves are constantly producing new leaves.

Senator AIKEN. A defoliant when a new growth is coming along fast will kill a tree, whereas if you wait until the new growth is matured, the leaves are mature, the damage would be less. So I assume.

Dr. MESELSON. That is an interesting suggestion, Senator Aiken. Perhaps that is one of the reasons why mangroves are so sensitive. We just do not know.

LACK OF KNOWLEDGE CONCERNING HERBICIDES

In fact, although a great deal of use has been made of herbicides, we do not know why they work. We do not know the mechanism by which they act. Probably when that knowledge is available, when we do understand why they are so toxic to plants, we will be able to design even more effective herbicides, for good or for ill.

I think that is one of the main lessons from the use of herbicides in Vietnam. I doubt that the United States would conduct an uncontrolled experiment like this again. I think we have learned. But the implication is that for the future other herbicides used by other countries could cause great devastation.

Senator AIKEN. I think it is another example of the rising cost of education.

IMPACT OF HERBICIDES ON HARDWOOD TREES

Dr. MESELSON. This photograph shows an upland semideciduous forest. These are hardwood trees. These forests have a fairly open floor with a dense cover formed by trees up to 150 feet high, with a rich population of animals at each level. A great amount of this kind of forest has been sprayed in South Vietnam. We conducted an aerial inspection of the area within a hundred miles of Saigon, in an arc going from the Cambodian frontier on the northwest to the South China Sea on the northeast. Most of the forest that we saw was badly damaged.

We flew over the area with a professor of botany from the University of Saigon and with a colonel from the U.S. Army Chemical Staff. We were surprised at the amount of damage that had been done. This particular area may have been sprayed more than once. Almost all of the trees are dead and the ground has been covered with bamboo. How long it might take for the bamboo to be replaced by forest trees is simply not known. It may be many decades. Many more decades would then be required before a mature forest could develop.

We do not know of any case of a large area of bamboo being replaced with trees.

HERBICIDAL CROP DESTRUCTION IN QUANG NGAI PROVINCE

This is an Army tactical map of a valley in Quang Ngai Province, which illustrates a different use of herbicides. The valley contained about 2,000 acres of rice paddies which were sprayed on August 9, 1970, in order to destroy the crops because it was believed that the rice was being used to feed the enemy.

We were flown over this valley by the chemical staff colonel who planned the mission. He told us that this was one of the best planned and most effective missions that he knew of. The military believed that the food in the valley was being consumed by enemy troops for four reasons:

First, it was thought that there were no houses in the valley, or very few.

Second, it was considered that the existence of terracing, of terraced rice paddies, indicated that the people down there had to be Vietnamese rather than Montagnard. The indigenous population in this mountainous region of Quang Ngai would be Montagnard rather than Vietnamese. Therefore, the planners of the mission felt the terraced fields indicated there were North Vietnam or Vietcong food production units in the valley.

Third, it was said that the amount of land under cultivation was greater than any conceivable indigenous population might need.

This is a photograph of the valley. Here you see the river going up. Here are the brown swaths where the agent blue was sprayed.

And fourthly, the chemical staff felt that the acreage planted had grown greatly in recent years, indicating an influx of enemy personnel.

We later looked into these pieces of evidence for this being an enemy crop production area and we found all four of them were wrong. We came to the conclusion, after examining this and other examples, after learning the results of official studies of the chemical crop destruction program that it is extremely difficult to distinguish civilian from military crops and that, in general, we have failed to make that distinction in Vietnam.

We submitted a report regarding this to Ambassador Bunker after we returned to the United States (see p. 357).

We found out there were many houses in the valley. When we developed our close-up photographs, we were able to see there were hundreds of well-kept looking houses, and that they conformed with the location of the houses on the military map of the valley, last revised in 1965.

The CHAIRMAN. Did you ascertain whether they were Montagnards or whether they were Vietnamese?

Dr. MESELOX. We could not be absolutely certain who was in the houses at the time of the spraying. But the mission had been authorized in Saigon 14 months before it was done and the indigenous population of the valley was definitely known to be Montagnards.

INTERVIEWS WITH REFUGEES FROM CROP SPRAYING

The CHAIRMAN. Had they all gone?

Dr. MESELSON. We were told there were many refugees from the crop spraying so we went to the nearest secure hamlets, where the refugees were and we interviewed them. Here are some of them. These are members of the Ire tribe.

These people are animists. They believe in evil spirits and good spirits. They believe that evil spirits are born in poison, and cause their effects by using poison. In a sense, chemical warfare fits in with their ancient tradition. They believe it is what the evil spirits use. And they believed that the American pilots had learned how to control the evil spirits.

Now when they have disease problems or a crop failure, they make animal sacrifices to appease the spirits. They kill chickens or dogs or pigs or, for serious problems, they kill water buffalo. These people told us they killed their chickens and their dogs and their pigs and their water buffalo and still the rice would not grow. They were not starving, for they had stores from the previous year's crop, but they felt their valley had been placed under a curse. They fled and became refugees here in the village of Ba To, and in other refugee camps.

We went to three separate refugee centers and interviewed refugees who had experienced anticrops spraying.

PERSISTENCE OF AGENT BLUE

The CHAIRMAN. How persistent is this agent? What is it—Blue?

Dr. MESELSON. Agent Blue.

The CHAIRMAN. Does it last beyond one crop season?

Dr. MESELSON. It may depend on the kind of land and the kind of rice. In the delta we visited areas sprayed 3 years earlier. We came by helicopter. No one could have known we were coming. We asked to see the rice and it was fine.

In the mountains, we were repeatedly told by the Montagnards that they were unable to grow rice for a year or two after the herbicide had been deposited on the ground.

The CHAIRMAN. Evil spirits?

Dr. MESELSON. It may be there are some differences. The Government of South Vietnam has been doing research on this and has learned in preliminary experiments that different strains of rice have different sensitivities to small quantities of Agent Blue. Also, the soil and the particular herbicide used could cause differences.

IMPOSSIBILITY OF MAINTAINING DISTINCTION BETWEEN MILITARY AND CIVILIAN CROPS

Regarding the terracing which was considered to be an indicator of a non-Montagnard presence, U.S. Army publication clearly state that the Montagnards of these valleys have been practicing terracing for decades. Terracing is not an adequate indicator of a non-Montagnard population.

We felt that the implication of this is that it is almost impossible under wartime conditions and with personnel who rotate as quickly as

ours do in Vietnam—this colonel only had been there a few months; he had not met his predecessor; he would leave a few months later—it is impossible to maintain that kind of distinction between enemy-grown crops and civilian-grown crops, and that as a result the impact of the program has been much greater on civilian-grown crops than on military ones.

EXTENT OF DEFOLIATION

The CHAIRMAN. You stated about 5 million acres of forests had been defoliated.

Dr. MESELSON. Yes.

The CHAIRMAN. Does that include the rice, the crops?

Dr. MESELSON. No, about a half million acres of cropland has been sprayed as part of the crop destruction program.

The CHAIRMAN. A half million?

Dr. MESELSON. A half million acres.

The CHAIRMAN. Is this all in Vietnam or does it include Cambodia?

Dr. MESELSON. This only includes South Vietnam.

SPRAYING OF CAMBODIAN RUBBER PLANTATIONS

The CHAIRMAN. Do you know anything about Cambodia? We have heard reports that they are spraying the rubber plantations.

Dr. MESELSON. Yes, there was an occasion on which rubber plantations suffered severe damage. The Department of State sent a team over there, Dr. Minarik and Dr. Tschirley. They verified there was herbicide damage, but I do not know what unit did the spraying.

Army officers in Vietnam and here have told me that the Army did not do it. I do not know who did it.

The CHAIRMAN. The evil spirits did. [Laughter.] Did you not say that?

CHEMICAL CROP DESTRUCTION INEFFECTIVE AS WEAPON

Dr. MESELSON. Our feeling about chemical crop destruction as a weapon is that it was ineffective.

The fundamental assumption is that somehow you can starve the enemy soldiers or make them divert scarce transportation facilities to bring in food from the outside. The difficulty, of course, is that the enemy soldier can be much more effective in obtaining food than is the civilian. The soldier can walk the next valley; he can coerce food; he can buy it with money; he can have it brought in. You would have to stress the civilian to an extraordinary degree before the soldier even feels it. Therefore, a program like this cannot be of much military value. Instead, it causes great suffering to civilian farmers and their families.

We are not experts in the military field, but that was the conclusion to which we came.

The CHAIRMAN. We had another report. It is similar to yours, I believe. It says,

The analysis indicated that the civilian population seems to carry very nearly the full burden of the result of the crop destruction program. It is estimated that over 500 civilians experienced crop loss for every ton of rice denied the Viet Cong.

Would you agree with that?

Dr. MESELSON. Well, it is very hard to compute an accurate number for the ratio of civilians to soldiers affected. It is easier to compute how many human beings could have eaten the food destroyed. We know how much food we have destroyed. It is enough to feed approximately 650,000 people for 1 year. That is the cumulative spraying from 1962 through 1969. It leaves out 1970.

Now 650,000 people for 1 year must have included a very large number of civilians, certainly far more than half, simply because in any 1 year there just were not anywhere near that many enemy soldiers growing their own food. Several official studies conclude that somewhere between 90 and 99 percent of the food being destroyed was destined for civilian consumption and not military.

I think this was a program that simply kept going under its own momentum. This program did require authorization at many levels, but the authorization became almost *pro forma*. We found that members of the principal committee that was authorizing these missions were unaware of the details of the targets which were being attacked. Now, as you know, the use of chemicals to destroy food crops in Vietnam has been stopped.

It is being done, according to newspaper reports, by another country, by Portugal in Angola, on the food crops of the people who are trying to displace the Portuguese from that African country.

IMPORTANCE OF RATIFYING PROTOCOL WITH HERBICIDES INCLUDED

I think this is the kind of warfare which, as Dr. Brennan has said, does not suit the kind of reputation and style and image which we have had in the past or which we should want to have in the future. Nor is it militarily effective, in my opinion. Beyond that it could stimulate thought regarding the possibilities of a far more dangerous tactic, biological anticrop warfare, something that could be a serious threat even to the United States.

I think that it is unlikely that the United States will use chemicals to destroy food crops again, but I think it is important that we now put ourselves in a position so that we can keep other countries from doing it. Ratifying the Geneva Protocol with herbicides included would give us that benefit. We would then be able to discourage others. We cannot do it now.

AUSTRALIAN USE OF RIOT GAS

The CHAIRMAN. You mentioned that Portugal was using this in Angola. This prompts me to ask you, since Portugal and ourselves were two of the three voting against the U.N. resolution, where is Australia using it and why did they vote against it?

Dr. MESELSON. Australia was using riot gas along with us in Vietnam.

The CHAIRMAN. They are not using it on any of their native population?

Dr. MESELSON. Not as a military weapon.

The CHAIRMAN. Have you any other questions?

Senator AIKEN. No more.

IS UNITED STATES SUPPLYING GASES OR HERBICIDES TO ANYONE?

The CHAIRMAN. Do you know whether we are giving away or selling or supplying any of these chemicals or herbicides to anybody, whether it is in the Far East or any other area? I guess the herbicide is a chemical, too, but I mean the gases. Do you know?

Dr. MESELSON. Riot gas and herbicides can be obtained on the commercial market and so can gas masks, but I do not know whether we supply these items as part of any military assistance program.

The CHAIRMAN. Of course, you were recently in Vietnam. You do not know whether or not we have supplied the South Vietnamese Army with gases or herbicides?

Dr. MESELSON. We have supplied the Government of Vietnam Army with riot gas weapons. Generally speaking, the weapons they have are the smaller caliber ones, mainly grenades.

The CHAIRMAN. Do you have anything else you would like to add?

PROHIBITION OF WEAPONS IS IN U.S. INTEREST

You have covered it very well. I think you and Dr. Brennan are in general agreement upon the value of these weapons to us, and if I understand it, you both agree that it is in our own interests that they should both be included in the prohibition; is that correct?

Dr. MESELSON. That is my essential point, Senator. I would not add anything to that.

The CHAIRMAN. So that if there is any other consideration, moral or material, that would only be in addition to our own interests.

I appreciate very much your coming. You have always been most generous with your time. I thank you very much.

We will be adjourned. Thank you.

(Whereupon, at 12:25 p.m., the committee adjourned.)