

WEATHER MODIFICATION

HEARINGS
BEFORE THE
SUBCOMMITTEE ON
OCEANS AND INTERNATIONAL ENVIRONMENT
OF THE
COMMITTEE ON FOREIGN RELATIONS
UNITED STATES SENATE
NINETY-THIRD CONGRESS
SECOND SESSION
ON
THE NEED FOR AN INTERNATIONAL AGREEMENT PROHIB-
ITING THE USE OF ENVIRONMENTAL AND GEOPHYSICAL
MODIFICATION AS WEAPONS OF WAR
AND
BRIEFING ON DEPARTMENT OF DEFENSE WEATHER
MODIFICATION ACTIVITY

JANUARY 25 AND MARCH 20, 1974

[Top Secret hearing held on March 20, 1974; made public on May 19, 1974]



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WEATHER MODIFICATION

FRIDAY, JANUARY 25, 1974

UNITED STATES SENATE,
SUBCOMMITTEE ON OCEANS AND
INTERNATIONAL ENVIRONMENT OF THE
COMMITTEE ON FOREIGN RELATIONS,
Washington, D.C.

The subcommittee met, pursuant to notice, at 10:05 a.m., in room 4221, Dirksen Senate Office Building, Senator Claiborne Pell [chairman of the subcommittee], presiding.

Present: Senator Pell.

OPENING STATEMENT

Senator PELL. This morning the Subcommittee on Oceans and International Environment is meeting to hear testimony concerning the need for an international agreement prohibiting the use of environmental modification and geophysical modification as weapons of war.

It is regrettable that this hearing must be held. It would not have been necessary if the administration had promptly responded to S. Res. 71, a resolution overwhelmingly adopted on July 11, 1973, as the result of a rollcall vote in the Senate. Six months later, there has not been the slightest indication that the administration is acting to meet a clearly expressed request of the Senate that the U.S. Government seek the agreement of other governments to a treaty prohibiting the use of any environmental or geophysical modification as a weapon of war. I hope this hearing will shed light on the reasons why no such action has been taken. I am sure it will reveal reasons why this action should be taken without delay. As I note below, I am afraid much of the responsibility for no forward movement rests at the door of the Defense Department.

The objective of S. Res. 71 has been endorsed by several national and international organizations. On the international level, the North Atlantic Assembly at its 18th meeting in November 1972, recommended a treaty to ban environmental or geophysical modification except for peaceful purposes. Domestically, in 1971, the National Academy of Sciences Committee on Atmospheric Sciences urged the U.S. Government "to present for adoption by the United Nations General Assembly a resolution dedicating all weather-modification efforts to peaceful purposes. "The President's National Advisory Committee on Oceans and Atmosphere" in its first annual report in 1972, strongly recommended that the United States seek international arrangements to renounce hostile uses of weather modification. Again, in 1972, the Sierra Club joined the Federation of American Scientists in urging that, "The United States should henceforth dedicate all

geophysical and environmental research to peaceful purposes and should actively seek the cooperation of other nations in programs of joint research on geophysical phenomena, their control, and their peaceful use."

However, despite the wide support for this concept, the Administration has failed to articulate a national policy on weather modification. This is due primarily to the intransigence of the U.S. military establishment. The military branches of our Government have steadfastly opposed the development of any policy in order to keep all their options open in the field of environmental modification. This response is, in my opinion, a shortsighted reflexive reaction. It does not represent a carefully considered, well-developed national policy. However, until such a policy surfaces, the military will have the freedom to indiscriminately experiment and operationally use this technology.

This is a situation which I find extremely distressing. If we do not restrict the military use of current environmental modification techniques, we risk the danger of the development of vastly more dangerous techniques whose consequences may be unknown or may cause irreparable damage to our global environment.

Military use of such techniques will affect the very important peaceful international scientific efforts now underway under the auspices of the World Meteorological Organization and the International Council of Scientific Unions—such programs as the Global Atmospheric Research Program (GARP) and "Earthwatch."

Instead of its official silence and actions condoning a gradual drift into environmental warfare, the administration should actively explore the advantages of a renunciation of such operations and the possible benefits stemming from an initiative for a multilateral "no first use" agreement. It is imperative that the United States enunciate a national policy on this subject, in no way blocking their development and in no way moving forward in the enlargement of human knowledge, but simply dedicating these efforts to peaceful purposes.

I hope that these hearings will spur the administration into some form of action to develop such a policy, as well as enlarging the body of knowledge available to the American public as to what geophysical and weather modifications actually imply.

[Text of S. Res. 71 follows:]

S. RES. 71

[Report No. 93-270]

IN THE SENATE OF THE UNITED STATES

FEBRUARY 22, 1973

Mr. PELL (for himself, Mr. BAYH, Mr. CASE, Mr. CHURCH, Mr. CRANSTON, Mr. GRAVEL, Mr. HART, Mr. HOLLINGS, Mr. HUGHES, Mr. HUMPHREY, Mr. JAVITS, Mr. KENNEDY, Mr. MCGOVERN, Mr. MONDALE, Mr. MUSKIE, Mr. NELSON, Mr. STEVENSON, Mr. TUNNEY, and Mr. WILLIAMS) submitted the following resolution; which was referred to the Committee on Foreign Relations

JUNE 27 (legislative day, JUNE 25), 1973

Reported by Mr. PELL, with amendments

JULY 11, 1973

Considered, amended, and agreed to

RESOLUTION

Expressing the sense of the Senate that the United States Government should seek the agreement of other governments to a proposed treaty prohibiting the use of any environmental or geophysical modification activity as a weapon of war, or the carrying out of any research or experimentation directed thereto.

Whereas there is vast scientific potential for human betterment through environmental and geophysical controls; and

Whereas there is great danger to the world ecological system if environmental and geophysical modification activities are not controlled or if used indiscriminately; and

Whereas the development of weapons-oriented environmental and geophysical modification activities will create a threat to peace and world order; and

Whereas the United States Government should seek agreement with other governments on the complete cessation of any research, experimentation, or use of any such activity as a weapon of war: Now, therefore, be it

1 *Resolved*, That it is the sense of the Senate that the
 2 United States Government should seek the agreement of
 3 other governments, including all Permanent Members of the
 4 Security Council of the United Nations, to a treaty along the
 5 following general lines which will provide for the complete
 6 cessation of any research, experimentation, and use of any
 7 environmental or geophysical modification activity as a
 8 weapon of war:

9 "The Parties to this Treaty,

10 "Recognizing the vast scientific potential for human
 11 betterment through environmental and geophysical
 12 controls,

13 "Aware of the great danger to the world ecological
 14 system of uncontrolled and indiscriminate use of environ-
 15 mental and geophysical modification activities,

16 "Recognizing that the development of weapons-
 17 oriented environmental and geophysical modification
 18 techniques will create a threat to peace and world order,

19 "Proclaiming as their principal aim the achievement
 20 of an agreement on the complete cessation of research,

1 experimentation, and use of environmental and geo-
2 physical modification activities as weapons of war,

3 "Have agreed as follows:

4 "ARTICLE I

5 "(1) The States Parties to this Treaty undertake to
6 prohibit and prevent, at any place, any environmental or
7 geophysical modification activity as a weapon of war;

8 "(2) The prohibition in paragraph 1 of this article shall
9 also apply to any research or experimentation directed to
10 the development of any such activity as a weapon of war,
11 but shall not apply to any research, experimentation, or use
12 for peaceful purposes;

13 "(3) The States Parties to this Treaty undertake not to
14 assist, encourage or induce any State to carry out activities
15 referred to in paragraph 1 of this article and not to partici-
16 pate in any other way in such actions.

17 "ARTICLE II

18 "In this Treaty, the term 'environmental or geophysical
19 modification activity' includes any of the following activities:

20 "(1) any weather modification activity which has
21 as a purpose, or has as one of its principal effects, a
22 change in the atmospheric conditions over any part of
23 the earth's surface, including, but not limited to, any
24 activity designed to increase or decrease precipitation,

1 increase or suppress hail, lightning, or fog, and direct
2 or divert storm systems;

3 “(2) any climate modification activity which has
4 as a purpose, or has as one of its principal effects, a
5 change in the long-term atmospheric conditions over
6 any part of the earth's surface;

7 “(3) any earthquake modification activity which
8 has as a purpose, or has as one of its principal effects,
9 the release of the strain energy instability within the
10 solid rock layers beneath the earth's crust;

11 “(4) any ocean modification activity which has as
12 a purpose, or has as one of its principal effects, a change
13 in the ocean currents or the creation of a seismic dis-
14 turbance of the ocean (tidal wave).

15 “ARTICLE III

16 “Five years after the entry into force of this Treaty, a
17 conference of Parties shall be held at Geneva, Switzerland,
18 in order to review the operation of this Treaty with a view
19 to assuring that the purposes of the preamble and the pro-
20 visions of the Treaty are being realized. Such review shall
21 take into account any relevant technological developments
22 in order to determine whether the definition in Article II
23 should be amended.

24 “ARTICLE IV

25 “1. Any Party may propose an amendment to this
26 Treaty. The text of any proposed amendment shall be sub-

1 mitted to the Depositary Governments which shall circulate
 2 it to all parties to this Treaty. Thereafter, if requested to do
 3 so by one-third or more of the Parties, the Depositary Gov-
 4 ernments shall convene a conference, to which they shall
 5 invite all the Parties, to consider such an amendment.

6 "2. Any amendment to this Treaty shall be approved
 7 by a majority of the votes of all the Parties to this Treaty.
 8 The amendment shall enter into force for all Parties upon the
 9 deposit of instruments of ratification by a majority of all
 10 the Parties.

11 "ARTICLE V

12 "1. This Treaty shall be of unlimited duration.

13 "2. Each Party shall, in exercising its national sov-
 14 ereignty, have the right to withdraw from the Treaty if it
 15 decides that extraordinary events, related to the subject
 16 matter of this Treaty, have jeopardized the supreme interests
 17 of its country. It shall give notice of such withdrawal to all
 18 other Parties to the Treaty three months in advance.

19 ARTICLE VI

20 "1. This Treaty shall be open to all States for signature.

21 Any State which does not sign this Treaty before its entry
 22 into force in accordance with paragraph 3 of this Article
 23 may accede to it at any time.

24 "2. This Treaty shall be subject to ratification by sig-
 25 natory States. Instruments of ratification and instruments of

1 accession shall be deposited with the Governments of the
2 United States of America, , and
3 which are hereby designated the Depositary Governments.

4 "3. This Treaty shall enter into force after its ratifica-
5 tion by the States, the Governments of which are designated
6 Depositaries of the Treaty.

7 "4. For States whose instruments of ratification or ac-
8 cession are deposited subsequent to the entry into force of
9 this Treaty, it shall enter into force on the date of the de-
10 posit of their instruments of ratification or accession.

11 "5. The Depositary Governments shall promptly inform
12 all signatory and acceding States of the date of each signa-
13 ture, the date of deposit of each instrument of ratification of
14 and accession to this Treaty, the date of its entry into force,
15 and the date of receipt of any requests for conferences or
16 other notices.

17 "6. This Treaty shall be registered by the Depositary
18 Governments pursuant to Article 102 of the Charter of the
19 United Nations."

Senator PELL. Our first witness today will be the representative of the Department of State, the Director of the International Scientific and Technological Affairs Bureau, Mr. Herman Pollack.

STATEMENT OF HERMAN POLLACK, DIRECTOR, BUREAU OF INTERNATIONAL SCIENTIFIC AND TECHNOLOGICAL AFFAIRS, DEPARTMENT OF STATE

Mr. POLLACK. Thank you.

My statement this morning will be brief.

Since I testified on an earlier version of this resolution in July 1972 the Senate adopted S. Res. 71 on July 11, 1973. In addition, you and the Secretary of State discussed S. Res. 71 during his confirmation hearings on September 10 and he has written to you on this subject on November 5.

As you know, in that letter the Secretary expressed regret that it was not yet possible to provide a coordinated executive branch response on S. Res. 71. He assured you that the matter would be looked into closely to determine how the executive branch might be responsive to the resolution's recommendations.

In this regard the President has directed that a study of the military aspects of weather and other environment modification techniques be undertaken. Further steps will be determined subsequent to the findings of this study and the review of those findings.

Mr. Senator, that concludes my statement. I will be glad to respond to any questions that you may have.

Senator PELL. Thank you very much.

DOD STUDY OF MILITARY ASPECTS OF ENVIRONMENTAL MODIFICATION

You are right, that is a very short statement indeed. Really it is a no statement statement, a no policy statement, but I am delighted to see that finally the President has directed that a study of the military aspects of weather and other environmental modification techniques be undertaken. I would like, if I could, to flush out public knowledge of this study.

When was this study requested? Of whom was it requested? And when is it expected that the reports will be available to the executive and to the public?

Mr. POLLACK. The study is directed to the Department of Defense. My understanding of the time available is not precise but I gather it has a deadline of several months given the scope of the area to be studied.

The decision to proceed with this directive was taken very recently. Senator PELL. Do you recall the date when the assignment was given?

Mr. POLLACK. No.

Senator PELL. It was given within the last week or so?

Mr. POLLACK. Yes.

Senator PELL. Was it done through National Security Council [NSC] framework?

Mr. POLLACK. I believe so, yes, sir.

Senator PELL. And the Defense Department was given the lead assignment in directing the study?

Mr. POLLACK. I don't think it is in terms of a lead assignment; I think it has the assignment to produce this product.

Senator PELL. And is there any indication as to who would be chairing the study? Would it be the Under Secretary of Defense?

Mr. POLLACK. I don't know, sir.

Senator PELL. But it is a Defense study and will be the same as the National Security Council interagency study?

Mr. POLLACK. My understanding, sir, as I reported, is that the President has directed the Department of Defense to do this. Precisely how it is to be described in terms of a NSC study I just cannot answer; I just don't know.

Senator PELL. Do you know if this is the first such study in the executive branch of the Government?

Mr. POLLACK. No; I think I reported in our last hearings a year and a half ago that an interagency study had been conducted. That study incorporated an examination of military aspects of weather modification but it reached no conclusions.

Senator PELL. That is right, it was a study but, as you pointed out, no conclusions were reached as to whether we should move ahead or not.

Mr. POLLACK. That is right.

ADMINISTRATION'S RESPONSE TO S. RES. 71

Senator PELL. Can you hypothesize for us as to why the inordinate delay in the administration's responses to the clearly expressed will of the Senate? I think it was with an 80-something to 10 rollcall vote that we requested the administration to move ahead in this field. Actually, I think it was a rather unique occurrence.

The Secretary of the Senate, if my recollection is correct, sent a letter to the President enclosing the resolution asking that action be taken. That was last June, I think, or July. It is now 6 months later; we are into 1974. What is the reason for this delay?

Mr. POLLACK. I don't believe I can illuminate that subject, I do not personally have the knowledge that would permit me to do so.

Senator PELL. Is it the view of the Department of State that movement in this direction would be advantageous to the national interest of the United States? Has the Department of State formulated an opinion itself?

Mr. POLLACK. I think your first statement would more accurately reflect our position. We do think this is a question that does need at some point to be determined, a position tentatively or otherwise taken. It remains our view as of this point that there is still an inadequate basis of information available to permit the kind of judgments that should precede a decision by the United States to pursue or not pursue a treaty on a subject of this complexity.

I would anticipate that we will possibly be in a better position to judge what our next steps should be when the review of the study that has been directed now by the President to the Department of Defense is in hand.

LEVEL OF SECURITY CLEARANCE FOR INTERAGENCY COMMITTEE MEMBERS

Senator PELL. In connection with the study that you chaired, the interagency committee, there are a couple of queries.

Do you happen to recall the level of security clearance that was generally held by the members of your committee?

Mr. POLLACK. By the members of that committee?

Senator PELL. Yes.

Mr. POLLACK. The committee members would have been cleared for top secret.

Senator PELL. And presumably that is certainly your clearance, if not higher.

ACCESS TO INFORMATION ON MILITARY USE OF WEATHER MODIFICATION

Why was your committee refused access to information at that time on the current military use of weather modification technology?

Mr. POLLACK. This question is one that we pursued at our last hearing.

Senator PELL. Correct.

Mr. POLLACK. And I don't recall exactly to whom the correspondence was addressed, but my recollection is Secretary Laird had established a position respecting the classification of activities in this area that makes it still impossible for me to deal with that subject in an open hearing.

Senator PELL. Right. My recollection is that Mr. Laird refused in open or closed hearing to discuss this problem in depth at all.

Mr. POLLACK. You may be correct.

Senator PELL. I would have thought it would have been hard for your committee at that time, in fact not only hard but impossible, to develop policy recommendations without knowing all of the facts, including military applications.

INTERAGENCY STUDY

To whom was your own final report submitted, the interagency study that you —

Mr. POLLACK. We submitted that to the Deputy Secretary of State, chairman of the Under Secretary's Committee.

Senator PELL. And did you have any recommendations or any results in the final part of that study?

Mr. POLLACK. The recommendations of that study were on the civil aspects. With respect to the military aspects, there were no conclusions reached.

ARGUMENTS AGAINST PROHIBITING USE OF ENVIRONMENTAL WARFARE

Senator PELL. What do you see, Mr. Pollack, as the arguments from the American viewpoint against such a prohibition?

Mr. POLLACK. I am sorry —

Senator PELL. What do you see as your own views with regard to the arguments against an agreement prohibiting the use of environmental warfare? What do you see as the negative arguments from your own knowledge?

Mr. POLLACK. From my own knowledge, I think I suggested some questions that need to be pursued but they are not in the nature of argument. There are some things I think undoubtedly will need to be examined at greater care.

Among them the difficulty of verification would have to be examined, I would think, with a great deal of care. The nature of some aspects of environmental activity such as rain cloud seeding, possibly done with very small planes would be very difficult to establish in a hard factual manner. Techniques may one day be developed that would make that possible. This is one of the things that would have to be examined with great care.

The difficulty of distinguishing between civilian and military research will be also, I think, a matter that will have to be looked into thoroughly. A good deal of work is being done at the moment with respect to fog dissipation directed at civilian airports. Matters of that kind that will have to be worked over.

CLIMATE MODIFICATION

I would like to amend slightly the answer I gave you to a previous question. As I reported at our last hearing and we had a brief exchange on this point. The Under Secretaries' committee provided the basis for a conclusion that the administration would not use techniques for climate modification for hostile purposes even should they be developed. So to that extent the report did dispose of one possible aspect of military—

Senator PELL. As I recall, the difference between climate and weather modification is basically somewhat similar to that between strategic and tactical warfare. Climate modification means changing the long-term climate or environment of an area that would have an effect over a period of years, whereas weather modification is a shorter term proposition.

Would that be correct?

Mr. POLLACK. Yes; and the other distinction I think I would make is that climate modification would affect an area of indeterminate size whereas weather modification is normally restricted to a fairly measurable and limited amount of territory.

Senator PELL. To give a specific example, the melting of the Greenland ice cap would be climate modification?

Mr. POLLACK. Yes; sir.

Senator PELL. While the reduction of the fog over an airport, no matter whether it is for good purposes to permit planes to land, or bad purposes to clear the air so you can see what you are bombing, that would be weather modification?

Mr. POLLACK. Yes.

GEOPHYSICAL MODIFICATION

Senator PELL. In which category would fall the element of geophysical modification, the artificial reduction of an earthquake a good many miles away by putting an exposure in the floors of the Earth surface?

Mr. POLLACK. You will have witnesses later this morning much better qualified than I to answer that question. My understanding is we

really do not at this point know enough about the consequences of that kind of activity to be able to provide you with an answer to that question.

CREATION OF HURRICANE

Senator PELL. What about the question of the creation of a hurricane; would that be weather or climate modification, in your view?

Mr. POLLACK. Well, the single hurricane, I would speculate, probably weather modification. But if the process by which a hurricane was created became subject to human manipulation, not knowing what that process would be, and whether it could be turned on and off, the consequence would be very significant climate modifications.

WEATHER MODIFICATION ACTIVITIES IN INDOCHINA

Senator PELL. Returning to the formal line of questioning, do you think that, although not admitted on the part of the Federal Government, that the fairly general assumption that the United States engaged in weather modification in Southeast Asia has any bearing on the executive branch's attitude with regard to possible future prohibition of such activities? If that is the case, I think we should be looking ahead and not behind.

Mr. POLLACK. Sir, since the question of whether or not the weather modification activities were carried on in Indochina, it is also a subject on which it is not possible for me to speculate on in an open or closed session for that matter. I can't find a way to respond to your query.

Senator PELL. I recognize your predicament and deplore the policy of the executive that puts you in that position.

INFORMATION PROVIDED ON WEATHER MODIFICATION

Is your department fully informed of all weather modification activities carried out by persons and agencies subject to the jurisdiction of the United States?

Mr. POLLACK. By persons or—

Senator PELL. By persons and agencies subject to the jurisdiction of the United States. In other words, are you informed of any weather modification activities that occur in the Pacific Ocean and the high seas or in the Far East or Sahara, as a matter of course?

Mr. POLLACK. Yes, I believe so.

Senator PELL. Even if done by the Defense Department or CIA or any other department, if outside the United States?

Mr. POLLACK. Any activity that is being carried on outside the United States. The thing that triggers the Department of State with respect to weather modification activities is the location of the activity. If it is overseas or would affect a foreign nation, the committee that we chair is involved. The committee's attention is triggered usually from a foreign government for either advice or support in rainmaking.

Senator PELL. I think perhaps like Watergate it was not that important compared with the interest that has come out after the bugging incident. This rainmaking in Southeast Asia is not all that important compared with the whole issue that we are discussing, but it is, I think, basic to it just like Watergate is basic to the whole crisis of Government today.

And in that connection, now that the war is over, and in view of the new spirit of cooperation that we do see with Dr. Kissinger as Secretary of State and his really very open relations with the Congress and with this committee, do you think this question can be settled as to whether or not we did engage in weather modification? I don't see anything awfully terrible if we did—what I do think is terrible is that the competent committees cannot be informed of it; the Congress cannot be informed and the American people cannot be informed of it.

As I said, it is very like the incidents of Watergate which have grown up much bigger. It is the same thing here. And I was wondering if you thought that this situation might change in light of the new spirit of cooperation which Dr. Kissinger referred to in his nomination hearings and which I think is really in being now.

It is a tough question.

SECRETARY KISSINGER'S ATTENTION TO QUESTION

Mr. POLLACK. No, not so tough. I think I could say with respect to that that you have played a major role in bringing Secretary Kissinger's attention to this question especially in the last 6 months and I have no question in my mind that your interest has had a constructive impact on the decision taken recently by the President in directing this study.

What I am unable to do is to anticipate either the consequences of the product of that study or the results of the review of it. But certainly there is now, there is now motion or movement—

Senator PELL. I appreciate that. You are quite right, I harrassed the Secretary publicly, privately, telephonically, on this subject because I think it is very important. It will give us an opportunity to take the lead as a peace-loving, peace-promoting Nation, and we did the same with the Outer Space Treaty.

OPPORTUNITY FOR U.S. TO TAKE LEAD

I remember when I first proposed the idea of a regime of law for the seas there was a good deal of laughter and reluctance, but we have actually accomplished a small portion of it in the Seabed Disarmament Treaty. I can see the opportunity here for the United States to take the lead in really a very important step toward world peace and toward preserving the environment. Thus, I keep pressing in this direction.

OPPOSITION WITHIN DOD

I can see no opposition anywhere except within the Defense Department.

Do you have knowledge, Mr. Pollack, of any opposition anywhere else in the Government besides the Defense Department?

Mr. POLLACK. Sir, I don't think it is a question of opposition as much as it is a question of inability to arrive at the kinds of judgments you like to have with you when you make a determination respecting initiating or supporting an action as important as a treaty in which the United States undertakes obligations of solemn character.

LENGTH OF TIME TO COMPLETE STUDY

Senator PELL. All right, I thank you very much for being with us this morning. I hope that the study will proceed.

Can you refine in any way the several months in which you think it will be completed?

Mr. POLLACK. When I used the term several months, I had in mind something like 3 to 4. That is at this point not a firm statement of how long it will take but that is my understanding—

Senator PELL. Right.

Mr. POLLACK [continuing]. Of the time.

Senator PELL. Thank you. Thank you very much indeed.

Our next witness will be Mr. Forman from the Defense Department.

STATEMENT OF BENJAMIN FORMAN, ASSISTANT GENERAL COUNSEL, OFFICE OF SECRETARY OF DEFENSE

Mr. FORMAN. Mr. Chairman, my opening remarks will be equally brief.

POLICY OF DEPARTMENT OF DEFENSE

Pending the outcome of the study to which Mr. Pollack referred, the position of the Department of Defense at this time remains the same as it was when I last testified, and specifically the position is as printed on page 35 of the last hearings.

Senator PELL. That is, with respect to the resolution?

Mr. FORMAN. Right.

Senator PELL. You might have been a little more courteous to the committee if you had that in writing rather than having us look it up. You ask a man what he has been doing and he said, "Read Who's Who, page 722." But I am looking it up here.

My vivid recollection is that your policy 18 months ago was a no policy policy, wasn't that correct?

Mr. FORMAN. Well, I wouldn't say it is a no policy policy. It is as Mr. Pollack just stated, that we don't have enough knowledge to make an informed judgment as to whether a treaty along the lines of the resolution would be in the national interest, that we don't have enough knowledge to draft one, and we don't have enough knowledge to know what would be required by way of verification or whether we would be able to verify such a treaty and, therefore, we took the position then and at this time still take the position, not that we are opposed to the treaty, but that the treaty be held, or the resolution or any efforts along that line be held, in abeyance.

EXECUTIVE BRANCH SHOULD PURSUE CONCEPT OF TREATY

Senator PELL. As you know, the Senate adopted this by a rollecall vote of 82 to 10 with some discussion both in the committee and on the floor and it was, as you know, unanimously adopted by all of the member nations of the North Atlantic Treaty Organization.

I would think that this would be a pretty strong indication to the executive branch that its job is to execute the policies set forth by the Congress, to carry out the laws of the Congress. This should be pursued more vigorously.

Why is it not being pursued more vigorously?

Mr. FORMAN. I am not sure I understand what you mean by pursuing something more vigorously. The concept of a treaty or our state of knowledge?

Senator PELL. The concept of the treaty. I think when we did the Outer Space Treaty our knowledge was very limited. I am not sure at that time we had men landed on the Moon. I think it was concluded before we landed the first man on the Moon, so knowledge was limited and yet we were able to move ahead.

Why can't we do the same with the weather and geophysical modification treaty?

Mr. FORMAN. As far as I recall our knowledge of space and space possibilities was far greater with regard to outer space than it is with regard to the environment.

I would like to amend or add to the opening statement I just made.

DOD WITNESS FOR CLASSIFIED HEARING

During my prior appearance you asked some questions which I was unable to respond to with respect to classified aspects of Department of Defense activities. The Department of Defense is now willing to provide a witness to this committee to testify in executive session on those classified aspects.

Senator PELL. Right. I appreciate that.

As you know, I have not sought a classified hearing because I think many of these things should be open and available in the press and available to the American public. I appreciate the willingness of the Defense Department in that regard and may well take advantage of this opportunity.

WEATHER MODIFICATION ACTIVITIES FOR MILITARY PURPOSES IN SOUTHEAST ASIA

But in our last open hearing, you indicated that you were under explicit instructions not to discuss the operation and use of weather modification activities for military purposes in Southeast Asia.

That is water over the dam, now, I realize that, but are you again operating under the same instructions as far as this open committee hearing goes?

Mr. FORMAN. You mean with respect to Southeast Asia?

Senator PELL. Correct.

Mr. FORMAN. Yes, sir.

Senator PELL. Even though its ended and over?

Mr. FORMAN. Again, I don't wish to leave any implication by my refusal to answer any questions in this open session that we either conducted such activities or did not conduct such activities.

LANGUAGE OF SEABED ARMS CONTROL TREATY

Senator PELL. Right. I was rereading the testimony last night, and the last time around on page 50 you said there that the Seabed Arms Control Treaty had similar language in its text, in that you were referring to the loophole that was put in at Stockholm at the request of the Defense Department with regard to environmental modifica-

tion. I asked my staff to look up the Seabed Arms Control Treaty and we could not find such similar language.

I was wondering if you could draw our attention to the phrase you were talking about.

I played a role, as you know, in this treaty and I was curious as to what you were referring. I think we are talking about the same one, the treaty on the prohibition of the placement of nuclear weapons.

Mr. FORMAN. Yes, sir. It may be that I referred to the wrong treaty.

I am sorry, sir, I can't find it at this point. My recollection was it was in this treaty, having worked on it actively. The natural conjunction of the fact that you had initially proposed it also led me to think it was in this treaty. But I do have the recollection of such language being in one of these arms control treaties.

Senator PELL. I think it may be in the Nuclear Test Ban Treaty, something of that sort, but I don't think it was in that one. I was reading it last night. I wondered where it was. Thank you.

[The information referred to follows:]

DEPARTMENT OF DEFENSE,
OFFICE OF GENERAL COUNSEL,
Washington, D.C., January 25, 1974.

HON. CLAIBORNE PELL,
Chairman, Subcommittee on Oceans and International Environment, Committee on Foreign Relations, U.S. Senate, Washington, D.C.

DEAR SENATOR PELL: During the course of my testimony today on S. Res. 71, you asked me to verify a statement I had made during the earlier Hearings conducted by your Committee in 1972 on S. Res. 281. That earlier statement, as printed on page 50 of those Hearings, is as follows:

"Mr. FORMAN. I think Dr. Pollack has indicated the basic reasons. I don't know that I can enlarge upon what he said other than to remind the chairman that, at least so far as I can recall, it is fairly standard language in these treaties to modify these absolute obligations by such words as 'to the maximum extent feasible' or 'where practicable,' and so forth.

"If I am not incorrect in my recollection, I believe the Seabed Arms Control Treaty, to which reference has been made, has similar language in its text."

Upon reexamination I find that my reference to the Seabed Arms Control Treaty was incorrect. The treaty I was thinking of was, in fact, the Outer Space Treaty of 1967. Article XI of the Outer Space Treaty obligates contracting parties "to inform the Secretary General of the United Nations as well as the public and the international scientific community, to the greatest extent feasible and practicable, of the nature, conduct, locations and results of such activities." [emphasis added]. In addition, language which has that import, that is, the words "fullest possible," appears in the following treaties:

Treaty for the Prohibition of Nuclear Weapons in Latin America, article 18, paragraph 2e;

Treaty on the Non-Proliferation of Nuclear Weapons, article IV, paragraph 2, and

Biological Weapons Treaty, article X, paragraph 1.

Sincerely yours,

BENJAMIN FORMAN,
Assistant General Counsel, International Affairs.

STUDY REFERRED TO BY MR. POLLACK

Has the Defense Department yet received instruction from the President to move ahead with this study that Mr. Pollack referred to in his testimony?

Mr. FORMAN. So far as I am aware we have not actually received a written document.

Senator PELL. Do you have any knowledge of who will be directing the study when it comes your way?

Mr. FORMAN. No, that would remain to be assigned once the document is received. It is possible that it might be under the aegis of the Director of the Defense Research and Engineering.

SELECTION OF COMMITTEES BY DOD FOR INFORMATION

Senator PELL. The information from this study is naturally of much interest to this committee. In earlier testimony, 1½ years ago, you indicated that the DOD had informed the chairman of the two Armed Services Committees and the two Appropriations Committees as to the classified nature of certain aspects of the Department's weather modification.

What is your basis for the selection of committees by DOD to inform?

Mr. FORMAN. Sir, that was answered last year in the record. I can't enlarge on that any more than we did last year. The correspondence begins at the bottom of page 41 and runs on over to page 43.

However, I would suggest that that in effect is water over the dam in view of the statement I made earlier that we are willing to provide a witness to testify before this committee.

AVAILABILITY OF RESULTS OF STUDY

Senator PELL. And would that include the results of the study when the time comes?

Mr. FORMAN. I can't speak to that. I don't know what the study classification will be, and since it is a study which we would be producing at the direction of the President and a report to him, that decision would be up to the White House. It would in effect be a White House or NSC document.

WEATHER MODIFICATION CAPABILITIES OF OTHER NATIONS

Senator PELL. Are you aware of any other nations that have the capabilities to use weather modification as a weapon of war?

Mr. FORMAN. It depends on what you mean by a weapon of war, how you define weapon of war. Certainly other nations do have a capability of engaging in certain weather modification activities such as fog dispersal or rainmaking. We have given that capability to some countries, as I think probably Dr. Amand will testify, as a result of our prior activities in those countries. When I say "we," I mean the U.S. Government or contractors working directly with those countries.

And, of course, as I said last time, sir, the research in this area conducted by the DOD as well as by other Government agencies is totally unclassified, so to that extent that research is readily available to anyone in the world. It can, of course, be used.

POTENTIAL USES OF WEATHER, GEOPHYSICAL MODIFICATION

Senator PELL. Is the research connected with weather and geophysical modification potential uses in the DOD unclassified?

Mr. FORMAN. Potential use? As distinguished from the actual research or any operations? Potential uses are classified but the actual research themselves and all operations conducted by the DOD are unclassified.

WHAT IS REASON FOR DOD OPPOSITION?

Senator PELL. As you know, we have been sparring with each other—your Department and this subcommittee—for quite a period of time. I remember the activities of your representative at the Stockholm Conference on Environment when I felt the position on environmental modification was somewhat gutted. I am left with the conclusion that the reason why the DOD is so opposed is either they want to keep their options open, which is a normal military viewpoint, or they are on the threshold of some really dreadful weapon that would be of use in war, or that it is simply a question of not wanting, of not knowing what its use would be and wanting to stand still. I was hoping that you could give us some sort of specific reasons in this committee based on the studies that have gone on already, or reasons of a general nature, your philosophical reasons if nothing else, as to why your Department really has been the main block in movement of this treaty. I am informed enough about the ways of the Government to know that it is not the Department of Commerce, the Central Intelligence Agency, or the National Security Agency, or the Agriculture Department that is opposing this treaty. It is basically the DOD.

I am trying to figure out the reason for the DOD position on this matter. Can you enlighten me in any way?

Mr. FORMAN. I don't think I can enlarge upon what I said last year and read into the record again that we just don't have enough knowledge to know whether such a treaty either as a whole or maybe some aspects of it would be desirable and in the national interest. We don't know enough.

POSSIBILITIES OF LANGUAGE CHANGES IN TREATY

Senator PELL. Do you see any possibilities of language changes that would safeguard the interest of the DOD in the sense that such lifting of fog so you could rescue a downed airman or lifting of fog from an airport, would be permitted? I can't imagine a treaty that would exclude them.

I would think there would be possibilities of working out language. Do you see that happening?

Mr. FORMAN. It is difficult for me to see that happening except possibly in reverse. Rather than working from what should be excluded from the treaty, working the other way might be more profitable, that is to say, as to what should be included.

We already, for example, have a Presidential decision made public in 1972, which renounces on the part of the United States the use of climate modification activities as a weapon of war.

Clearly, therefore, the executive branch is on record that we would have no opposition to a treaty which banned that particular technique as a weapon of war. So if you go from that point down the scale, there might be some possibilities. But to work from the bottom of the scale up you get into the problem of what do we know about the subject and do we know enough to be able to say we are willing to renounce a

particular technique. On the other hand, it is conceivable that we might be willing to say that no matter what we know about the technical possibilities, it is so horrendous, such as climate modification, or biological weapons, that it should be renounced.

Senator PELL. The fact of the matter is we have more knowledge—although we renounced climate modification as a weapon of aggressive war—we have more knowledge about weather modification than we do about climate modification, don't we?

Mr. FORMAN. Yes, sir.

Senator PELL. We renounced the use of the weapon of which we have the least knowledge. If we go against your view that we shouldn't go ahead with this because we don't have enough knowledge—

Mr. FORMAN. But, Senator, your treaty—for example, you just said that of course fog dispersal shouldn't be covered. Well, there is nothing in your draft, as I read it, that excluded it.

Senator PELL. Fog dispersal for humanitarian and peaceful purposes.

Mr. FORMAN. I am not sure I understand what you mean by that.

Senator PELL. By that I mean fog dispersal to rescue a downed airman or clear a civilian airport, yes. Fog dispersal to clear a factory so that it can be more visible to be bombed, no. That is the purpose of the treaty. The language can be changed going in that direction but obviously—

VIEWS OF DOD

Mr. FORMAN. Senator, I have difficulty in responding to this line of questioning because, as I say, the position of the Department of Defense is as I have stated.

Now if you wish me to respond, not on behalf of the Department of Defense, but speaking personally as an individual, I would be happy to do so.

Senator PELL. Well, I appreciate that, but I am particularly interested in the views of the Department of Defense.

Mr. FORMAN. The Department of Defense doesn't have any views other than the views I have stated several times now and reiterated what we said last year.

PERSONAL VIEWS OF WITNESS

Senator PELL. Speaking personally, then, do you see the possibility of moving in the direction that I have suggested?

Mr. FORMAN. Speaking personally, I have a number of difficulties, and again I reiterate I am not speaking for the Department of Defense but speaking individually as a lawyer and someone who reads the newspapers. There shouldn't be any implication read into what I am about to say that it represents the position whatsoever of the Department of Defense, any views of the officials of the Department of Defense, or that it is what we are actually thinking along these lines.

Now, first let me say, before I get into an analysis of your resolution, that while it is undoubtedly true, as you say, your resolution has found some support, particularly in the Senate, the NATO Parliamentary Conference and some other bodies, I don't believe it has that support among other nations at this time.

DIPLOMATIC CONFERENCE ON INTERNATIONAL HUMANITARIAN LAW

As you probably know, there is going to be an international conference convened in Geneva beginning in February and running for 6 weeks on some of the Laws of War. Two protocols have been prepared by the International Committee of the Red Cross. There are a number of proposals pending by other nations.

Some of those proposals would lead, if adopted, to the banning of some items of ordnance such as napalm. I know of no proposal by any country, however, which would ban any form of weather modification as an illegal weapon or method of warfare or means of warfare.

Senator PELL. Excuse me for interrupting here, but I follow that conference fairly closely and hope to attend it at some point. As you, I think, must know, it is not intended to deal with such a general and somewhat theoretical and future subject as weather modification, but with the specific applications of rules of warfare now to civilian populations, and as you suggest, to some of the specific weapons in hand.

Mr. FORMAN. Well——

Senator PELL. I think it would be improper to bring up weather modification at the Diplomatic Conference on International Humanitarian Law.

Mr. FORMAN. My own view is it would be improper to bring up the specific weapons because basically that conference is a conference not on the laws of the war—that is, conduct of actual hostilities—but on what you do after hostilities have ended.

Senator PELL. Correct.

Mr. FORMAN. But there is an effort by some countries to get into what we call the laws of war; that is, the Hague regulations, as distinguished from the Geneva Conventions of 1949. I merely make the point that despite the interests there may have been among such organizations as the Parliamentarians Conference of the North Atlantic Treaty Organization, or scientific bodies, that pressure has not made itself felt in the official positions of government in this forthcoming conference, and there are at least some countries that are desirous of banning some weapons. I make that as an aside.

Senator PELL. But also the law of the sea, which is obviously of some interest now, moving to the conference in Venezuela; the only voice that was raised for it was the voice of Malta, not the greatest nation in the world, and in the Congress here, my own; but these ideas do move along.

I think the fact that it is not being discussed at the Diplomatic Conference on International Humanitarian Law in General is really rather immaterial.

At any rate, carry on.

CRITIQUE OF RESOLUTION

Mr. FORMAN. With regard to your resolution, my first observation is that it is too broad in scope. I think you have indicated by your own statements just a few moments ago that it is too broad in scope.

I don't believe it can be said, as your resolution says, that all modification activities constitute a great danger to the world's ecological system. I don't think there is evidence all such activities do that.

Similarly I don't think there is any basis for the statement that all weapons-oriented—depending on what you mean by weapons-oriented—modification activities create a threat to peace in the world. Certainly the fog dispersal doesn't.

Now, paradoxically—and this is my second point—I don't think your treaty is broad enough in that you are dealing solely with the use in wartime of these activities.

If there is a danger to the world's ecological system—and I don't dispute there is a danger that certain activities can produce to the world's ecological system—that danger is equally great, if not greater, in peacetime activities than it is in wartime activities.

For example, in the field of climate modification, melting the polar ice caps, let us say, in Canada or Siberia, for purely peaceful purposes—to change the climate of those countries and make it possible to provide more arable land for people to farm, provide access to the metal resources—creates a danger for greater than the remote possibility that nations would use climate modification as a weapon of war.

If these dangers exist—

Senator PELL. I realize it would be very unpleasant for my own State of Rhode Island if that occurred.

Mr. FORMAN. The same thing is true with respect to hurricanes. Research on hurricanes, trying to steer hurricanes or other hurricane modifications, for purely peaceful purposes, is not without danger. If that danger exists, and you believe it exists, then you should be pushing forward for a treaty either to ban these activities, whether it be in time of peace or war, or at the minimum to see to it that these activities are subject to complete international control and supervision, and, possibly licensing.

Third, the point already has been made in the prior hearing that it is impractical to distinguish, as your treaty tries to distinguish, between research for peaceful purposes and research directly to the development of such activity as weapons of war.

The research is the same. Basic research is basic research. What one does with it is something else. One can't discern the potential uses of the research when the research is being done, and one can't verify that research is being done for peaceful as distinguished from weapons of war purposes.

Fourth, I believe you have some technical defects in drafting, Senator.

Your article I, paragraph (1), for example, says—

That States Parties to the Treaty undertake to prohibit and prevent, "at any place," such activity. From a legal viewpoint, however, we cannot prohibit and prevent "at any place."

How could the United States, for example, prohibit some other country or prevent some other country from doing it?

Obviously what has been done here is to leave out language which appears in some other treaties; namely, the words "in any area under its jurisdiction or control." What is needed is a two-part obligation; namely, that a nation undertakes not to use and also to prohibit and prevent in any area under its jurisdiction and control.

Senator PELL. I would agree with you on that.

HOW IS "WEAPON OF WAR" DEFINED?

Mr. FORMAN. You also have a problem when you say use as a weapon of war. How do you define a weapon of war? What do you mean by weapon of war in this instance?

I was doing some scribbling of notes just before I came here and thinking of some of the possibilities as to how weather modification might be used in wartime. I don't know what you would consider to be undesirable or desirable to be a weapon or not a weapon, but certainly weather modification is at least a possible means, method, or tactic in wartime.

Let us take, for example, fog dispersal or lightning and hail suppression. Now that is just one grouping of activities. In analyzing that grouping, Senator, you have to look at it not in the abstract but along various points of departure.

First, where is the activity taking place? Is it taking place on U.S. or allied territory? Is it taking place on enemy territory? Is it taking place over international waters?

And then what is the immediate purpose of it? It can be either aircraft taking off or aircraft landing.

What missions may those aircraft be performing? They can, as you said, be performing a search and rescue of downed pilots on land or sea. They can be search and rescue of the crews of ships that have been sunk. They can be logistic support and administrative flights. They can be medical evacuation. They can be ASW [Anti-Submarine Warfare] patrols. They could be convoy protection. They could be the launch of fighters for interception of aircraft coming from the enemy. They could be close air support of ground troops. They could be tactical air support of naval patrols. They could be for reconnaissance. They could be for bombing of targets. There could be a combination of missions within one time period.

Does it make a difference from your viewpoint whether the fog dispersal or lightning suppression or lightning and hail suppression took place in our own territory or allied territory versus whether it took place in enemy territory and, if so, why?

Some people might say, for example, it is all right to have fog dispersal at our own airfields, in our territory or allied territory, to take off to bomb a target in the enemy territory. I don't know whether you would say that is all right. As I understand it, you do say that it shouldn't be all right to have fog dispersal at the end of the mission so that we can bomb the targets. I don't see the difference. Either way the same technique has permitted you to accomplish the result, and parenthetically, I might add that current international law does not ban bombing when the weather is bad and the target is obscured.

If you say there is a difference, well, No. 1, I don't see it morally. No. 2, in effect you are creating a dual system which penalizes less developed countries more than developed countries. You are saying that a country which might be able to do the fog dispersal, because it doesn't take much scientific knowledge to do that, can't do it and, therefore, can't engage in effective combat. Whereas with respect to a country that has an advanced capability in the electronic field, or in the optical field, to be able to get off an airfield regardless of fog, or be

able to see the target regardless of fog, it is perfectly lawful for them to do it. That doesn't make sense to me. Nor do I understand the morality of prohibiting a means for facilitating the identification of military versus civilian targets.

I could go on along these same lines with regard to fog creation and rain enhancement or inhibition and so forth.

My point simply is that if you want to write a treaty along these lines you can't just say in the abstract it is all bad; you have to look at it in terms of what it is, where it takes place, what the ultimate mission is that the military is doing, and what alternative means or methods of warfare would be used in place of the ones prohibited. It is very hard to draw and enforce the line once you have got all of these possible, sometimes concurrent missions. I have listed 11 just out of my head. I am sure there are far more.

LOCALE WHERE MODIFICATION TAKES PLACE

Also, I don't think you can overemphasize the locale where the modification activity takes place. For example, the problem of devastation or destruction of territory. It may make a difference legally whether one is talking of one's own territory or not. In this connection, you had some testimony last session by Professor Falk and he cited some Nuremberg war crimes cases. His citations were not complete. Not all devastation even in enemy territory is illegal. One of the war crimes cases did acquit some Germans of devastation because it was shown to have been required by military necessity during a retreat.

As to one's own territory, let me remind you, for example, of the War of 1812 where the Russians adopted a scorched Earth policy retreating from Napoleon. More recently, we destroyed, for example, some oil properties in the Philippines to prevent the Japanese from capturing them at the outset of World War II.

There is certainly nothing illegal in destroying your own property in your own country to deny that property to the enemy.

Further, for example, in the contest of rainmaking or snow enhancement, let us assume a situation of Switzerland being attacked through its mountain passes. Should it be illegal for Switzerland to have a capability and use a capability of making snow in those passes to cause avalanches to destroy those troops on its own territory? I submit that it shouldn't be.

UNKNOWN FACTORS

In conclusion, I recognize that what you have done in this effort, Senator—as you have stated in your report and on the floor—is not to attempt to write a definitive treaty. You are merely trying to stimulate discussion and analysis. There is certainly a lot more analysis that needs to be done. But to a large extent, once you get beyond fog dispersal or rainmaking, and I don't know what else is possible today, you get to an area where, as I have said previously, when speaking as an official witness of the Department of Defense, there is so much we don't know that we are not sure just how one should write this kind of a treaty, unless, as I said, you proceeded piecemeal and eliminated things which are clearly to be forbidden, such as climate modification.

Senator PELL: Thank you. I appreciate very much your personal remarks and find them very helpful.

TYPE OF AGREEMENT TO BE NEGOTIATED

Actually, as you know, as you pointed out yourself, in my report on this resolution, I said that the treaty was a model or example of the type of agreement that the Senate would like to see negotiated. I am not a lawyer. But exactly the same technique as I have pointed out was used in the law of the sea with actual specific results already accomplished, and results to come we hope in either Caracas or Venezuela in the future for the general law of the sea.

HOPE THAT U.S. WILL TAKE LEAD IN FIELD

If the Department of Defense would be specific in its comment, as you as an individual have been, I would be delighted, because then we would get into dialog. The problem here is there being so little dialog, I think some of the points you made are perfectly valid. Other points I think are not valid and shouldn't be covered, but at least there would be a dialog going. I very much hope that we will take the lead when the time comes in this field and not leave it up to Malta, which is really what happened with the law of the sea. Let the United States be the principal piece blazing the way toward peace and not the other nations in the world.

I thank you for this statement very much indeed. I would hope that your study will move ahead.

TIME FRAME FOR STUDY

What is your view as to the time frame when the study will be completed?

Mr. FORMAN. I just can't answer that question, Senator, because as I said earlier, we have not actually—at least as of the time I left the Pentagon to come up here—we had not actually received the physical document from the President directing the study. It may well be that that document does have a due date set forth in it. I just don't know.

Senator PELL. There is no reason it couldn't be done within a very few months, is there?

Mr. FORMAN. I would assume it would be called for to be produced within some months.

CHANGES IN DOD'S POSITION

Senator PELL. Since we last conversed, 18 months have gone by. DOD's position has changed in two respects. One, that you are willing to give us a classified briefing, which you were not then, and, second, you are willing to speak as an individual.

That is progress, I guess, but maybe less than 18 months from now there can be, I would hope, not only progress along these lines but agreement on a draft that we could actually push.

I thank you for being here very much indeed.

Mr. FORMAN. Thank you, Senator.

LACK OF SPECIFIC DOD COMMENT

Senator PELL. And I hope you will press hard and also take back with you to the Defense Department for the record my own still

profound disappointment at the lack of specific departmental comment that there is on this, and what I think is ignorance of the will of the Senate to move faster with response and my recollection is, as I mentioned to Mr. Pollack, that never before has a Senate resolution been forwarded to the President by the Secretary of the Senate asking for action, and the reason we went through this procedure was to underline the seriousness which some of us in the Senate felt the study should be given to this proposal.

Thank you very much.

WITNESS ORDER CHANGED

I am going to take our next witness a little out of order, but being struck with some of the informal points that were made by Mr. Forman, and having the chance to glance through the testimony of the witnesses last night, I would like to now ask Mr. James Leonard, vice president for Policy Studies of the United Nations Association, an individual who is very familiar with disarmament and played a substantial role in the achievement of the Seabed Disarmament Treaty, in fact was the negotiator for it, if he would come forward and not only put forth his testimony but he might care to comment on some of the personal views as to the drawbacks in this treaty on the part of Mr. Forman.

Mr. Leonard, Ambassador, once an Ambassador always an Ambassador.

STATEMENT OF JAMES LEONARD, VICE PRESIDENT FOR POLICY STUDIES, UNITED NATIONS ASSOCIATION

Mr. LEONARD. Thank you.

May I just preface my remarks, sir, by saying, as you know, I am here in my personal capacity and not any way representing the views of the organization that employs me.

I have a prepared statement, Mr. Chairman. I don't know whether you would like me to read it.

Senator PELL. I have had the opportunity to read it and since there are no colleagues here with me, maybe you would care to just digest it and move on to comment on Mr. Forman.

Mr. LEONARD. Thank you, sir.

Senator PELL. It is an excellent statement. I enjoyed it.

CONCEPT ADVOCATED IN S. RES. 71 SUPPORTED

Mr. LEONARD. Well, as you know from the statement, I do strongly support the concept that you are advocating in S. Res. 71 and outline in the statement the arguments that I feel weigh most strongly in favor of that course of action.

PROPOSED STUDY

I came here this morning hoping that it would be necessary to modify this statement as a result of the testimony that would be given by Mr. Pollack and by Mr. Forman, two extremely competent officials, and I am pleased to note that is in fact the case, that you have

had good news from your witnesses already this morning in that they can report that there is now a study underway.

I think that this committee can congratulate itself on having at least accelerated that study, although the rate of acceleration has been rather slow. Eighteen months is a long time to get to this operation.

I trust that it will move along briskly now and that when the time comes for the results of the study to be put in front of the public, which I would hope would be reasonably soon, I would particularly hope that the representatives of agencies other than the Department of Defense will be able to say that they had made available to them all the information necessary on all of the activities of the U.S. Government in this area.

I think it would not be possible for this study to be carried through effectively if only a part of those participating in it have access to classified information of various categories.

REPRESENTATION OF ACDA AT HEARING

Senator PELL. I point out that last time at our hearing ACDA, your former agency, was represented. This time they did not seem enthusiastic about coming forward, and so that is the only reason they are not here. They didn't feel under these circumstances they could contribute much.

I would hope next time we have a hearing on this subject they would be here, and I would hope, too, that the ACDA would once again take the lead in Government to balance the Defense Department position. So far there have been no signs of this, but we will wait and hope and pray.

Mr. LEONARD. I also, Mr. Chairman.

If I may just deal with one or two points that have come up in the testimony so far, I think that I might be useful.

HOW TREATY MAY BE DRAFTED

I am very encouraged by Mr. Forman's testimony in particular because I think the fact that he is turning his excellent mind to this question as to how a treaty may be drafted may perhaps indicate that this question is being taken seriously in the Defense Department as well as other parts of the Government.

With respect to the particular comments that he made I don't feel that I could simply off the top of my head, as the expression goes, deal with each of them. I do feel that in general the objections, criticisms, that he raised, although they do have a point, are the sort of elements that generally are taken care of either by redrafting the language of the treaty itself, as a process which goes on at great length, of course, during negotiations of a treaty, or in some cases simply by making clear in the negotiating record what is meant by particular language that is perhaps not totally clear or is in danger of meaning two different things to two different groups.

I would think that the basic position that we simply do not know enough to draft a treaty was in effect taken care of by your own comment when you pointed out that we do feel we know enough to eliminate climate modification and we know a great deal more about weather modification.

We always proceed in these things in the absence of total knowledge. I don't think there is any branch of science where the human race has come to know everything there is to know, and that certainly is going to be true for quite a long time to come about weather modification and climate modification, but as I indicate in my prepared statement, I don't think there is any doubt we know enough to go ahead and eliminate certain activities which are harmful or run the risk of being harmful.

INTENT OF RESEARCH

I could just mention briefly one particular point which a number of witnesses in the previous testimony before this committee also referred to, and it is the problem they see in the ability to distinguish between research which is peaceful in intent and research which might have a military application.

This is a problem which comes up again and again in arms control contexts but it is one which I believe I am correct in saying has been dealt with in arms control contexts through the application of the criterion of intent; that is, a treaty bans research or activities of various sorts which have a specified intent and permits other kinds of activities which have intent which is deemed to be desirable.

Unless I am mistaken, the Biological Weapons Treaty has this sort of distinction contained in it, but I haven't referred to the text in the last few minutes so I can't assert that with complete confidence.

Senator PELL. Which treaty?

Mr. LEONARD. The Biological Weapons Treaty.

INTERNATIONAL SUPPORT FOR PROPOSAL

I would like to comment also on the point of international support for a proposal such as you have been putting forward. I think there isn't much doubt that a U.S. initiative along these lines would be widely welcomed.

I do feel, however, that Mr. Forman has put his finger on one aspect of this. There are a number of other items on the arms control agenda also, and if the U.S. Government were to put forward an initiative along these lines, with the intention of distracting the international community from these other arms control issues, I think that this initiative would not be welcomed.

Specifically in the field of multilateral arms control, there is very strong desire on the part of most countries to have a comprehensive test ban to conclude the work begun in Moscow in 1963, by banning underground tests, and there is, I think, a strong desire to move forward in the field of chemical weapons, to do something about the production and stockpiling of chemical weapons, and if we simply attempt to divert people from those objectives by putting forward a proposal in the area of environmental warfare, I think they will tend to conclude that this is not an important area and not an important addition.

That could be a wrong conclusion but it would be a natural one for many other countries to reach.

I would hope, therefore, that anything we do in this field is accompanied by initiatives in other fields to show our good faith and desire to move forward in the arms control field generally.

Mr. Chairman, that is all I have.

EXECUTIVE BRANCH'S FAILURE TO DEVELOP AND ARTICULATE POSITION

Senator PELL. In your opinion, why has the executive branch failed to develop and articulate a position on this point? What was the reason why we have not been able to move ahead even though there has been considerable request and force from the Congress?

Mr. LEONARD. Well I think, Mr. Chairman, the problem has been largely that it was met with opposition within the military establishment and it was not given sufficiently high priority by other parts of the Government to overcome this opposition and to move the question onto the front burner, as the expression goes.

DESIRABILITY OF DOD TAKING LEAD IN STUDY

Senator PELL. Do you think that it is correct or desirable that the DOD take the lead in the coming study that has been assigned by the President?

Mr. LEONARD. I am sorry, I was not aware that was the case. Has that been the testimony?

Senator PELL. That is what Mr. Pollack said. The President has issued instruction that a study be done as to the merits of weather modification and the desirability of moving ahead along these lines of the treaty. The responsibility for carrying out this mission has been given to the Department of Defense.

Mr. LEONARD. Well, Mr. Chairman, if the task assigned is that of examining whether there should or should not be an arms control treaty, I would think the Arms Control Agency is the one that should be given the primary responsibility.

I recognize the basic knowledge on this subject lies within the Department of Defense and their cooperation is more than essential.

PARTICIPATION OF ACDA

Senator PELL. I would have thought so. As you know, the ACDA has taken a remarkably low profile in the last 18 months, and it is regrettable. That the study should have been given to them was my own reaction.

When you were working on the study before that was done within the U.S. Government, and Mr. Pollack was the chairman of the group, was ACDA participating in that study?

Mr. LEONARD. I believe it was, Mr. Chairman, although at that time I think I was in Geneva and not in Washington. I am quite confident in fact ACDA was a participant in the group.

Senator PELL. I believe it was, too.

U.S. RESPONSE IF ANOTHER NATION PROPOSED SIMILAR CONCEPT

Did you think the United States would respond in a constructive way if another nation proposed a concept similar to our own draft treaty proposal?

Mr. LEONARD. I think, Mr. Chairman, that the process would be essentially the same, that the interagency decisionmaking operation would get underway and would come to essentially the same conclusion whether it was a U.S. initiative or the initiative of some other government.

As you may recall, in the case of biological weapons, that was a British initiative which we then examined and came to a positive conclusion with regard to.

Senator PELL. I must say I personally am very disappointed that Mr. Ikle and the ACDA, to the best of my recollection, have not shown any interest or enthusiasm in connection with this concept in the last year or so.

I would hope, of course, they would become interested in it.

WITNESS' STATEMENT COMMENDED

As you know, your statement is going to be inserted in full in the record, and it is excellent testimony.

WAYS OF PUSHING AHEAD MORE VIGOROUSLY

Do you have any good advice to make where you sit as a civilian as to how I can push this ahead a little more vigorously? I don't want to reach the point where the weapons are all in hand because then it is usually more difficult to get a treaty in being than when the weapons are perhaps in the future.

Mr. LEONARD. Well, I would hope, Mr. Chairman, that you would, after a reasonable time has gone by, inquire vigorously of the executive branch what it has been up to and perhaps call hearings in order to ascertain what their responses are at that point.

I have also in my prepared statement suggested another approach, which is to include in the money bills of the Department of Defense a limitation that would, I think, encourage them to take seriously the position of the Congress in this respect.

COMMENDATION OF WITNESS

Senator PELL. Thank you. Thank you very much indeed and let me congratulate you on the role you played in the Seabed Disarmament Treaty and wish you well in your new job.

Mr. LEONARD. Thank you very much.

[Mr. Leonard's prepared statement follows:]

PREPARED STATEMENT OF JAMES F. LEONARD

I strongly support the concept advocated in Senate Resolution 71.

The arguments which I feel weigh most heavily in favor of a United States initiative along these lines are briefly the following:

- (1) There is not, I believe, any valid military argument for our retaining the option to use environmental warfare;
- (2) There already is and will continue to be a substantial cost to us in scientific terms if we continue to protect this option; and
- (3) We are paying a substantial political price for our failure to take the leadership in closing off the possibility of environmental warfare.

In what follows I will focus on weather modification. The other forms of environmental warfare appear, from what I have been told, to be somewhat more remote and the arguments applying to them are in large part the same as those for weather modification.

Let me address briefly the military argument that weather modification may be developed into an effective weapon which the U.S. might some day want to use. To support this argument a variety of scenarios are advanced. With one exception, I find these scenarios either "incredible" or "marginal." The "incredible" scenarios postulate U.S. involvement in important wars in remote and underdeveloped

areas—wars which common sense tells us either will not occur or will not draw us in. These quite unconvincing scenarios are invented in an attempt to describe a situation where we would be facing adversaries who would not be able to use weather modification effectively against us. The Vietnam war has been, of course, the inspiration for these scenarios. I think it will be a long, long time before we again get into any comparable situation.

The other, "marginal" scenarios are somewhat less unbelievable. But they necessarily involve opponents with a high technological capability. These opponents should prudently be expected to be able to use weather modification about as effectively as the United States, if in fact the possibility of effective use exists. Such scenarios therefore offer the United States only a marginal or even a negative military advantage. A war in Europe is one example. Such a war is not likely. But if one were to occur, it is extremely unlikely that the NATO countries would be able to use weather modification to great advantage in defending themselves against an attack from the East. I, at least, have never seen arguments to the contrary which were at all persuasive. Thus, in military terms weather modification looks to me like certain types of insurance which unscrupulous insurance agents sell to timorous individuals to "protect" them against utterly unlikely risks such as tidal waves in Utah. If such an individual is rich enough, the cost of the insurance may do him no great harm, but the United States is not infinitely rich and in my view the costs of this particular "insurance policy" are significant.

I said earlier that with one exception the scenarios for using weather modification were either incredible or marginal. The exception is, I believe, quite unlikely, but it is unhappily not to be completely ignored. I refer to the possibility that some form of weather modification might be developed into a truly effective weapon of mass destruction. I do not expect that this will happen, but even the remote possibility is a valid reason for doing everything that we can—along the lines recommended in your resolution—to ensure that no such weapon is developed. The reasoning here is obvious. The United States does not need any more weapons of mass destruction. Our nuclear arsenal is already far larger than any rational military or political requirement and it is sufficiently varied in its characteristics to meet any likely contingency. And, obviously, neither our security nor world peace would be furthered if other nations should get possession of a new weapon of mass destruction. Rather the contrary. The development and even a limited dissemination of such a weapon could in a real sense negate the Non-Proliferation Treaty. It could lead to devastating wars whose effects could reach out far from their point of origin. This is the key consideration to bear in mind with regard to other forms of environmental warfare. It is, presumably, the argument which led the government to renounce climate modification, unilaterally and without even soliciting reciprocal action from other states.

In sum, an examination of the basic military considerations leads me to conclude that further development of weather modification or other forms of environmental warfare either would be, at best, of negligible utility to the U.S. or would be truly dangerous to our security.

What, on the other side of the ledger, are the costs of our failure to outlaw environmental warfare? One area in which we pay a price is the scientific development of the capability to use weather modification for peaceful, beneficial purposes. The magnitude of this cost is obviously difficult to assess and others are better qualified to do this than I, but common sense leads directly and plainly to the conclusion that other nations will be slow to cooperate with us, their scientists will be reluctant to work with ours, so long as they can fear that their contributions to the science of meteorology and to the technology of weather modification may boomerang in the form of U.S. military actions against their nation or their neighbors.

I hope that you will be developing from other experts a picture of what weather modification can do if pushed vigorously for legitimate ends. I would only note that what the experts are saying about the threatening character of the world food balance over the next few decades makes me hope that any possible help which the world might obtain from weather modification will in fact become available to us.

Our government's unwillingness or inability to decide that we don't want military weather modification is costly also in the political area. Over the past decade the United States led the way to a series of arms control treaties which brought real benefits to the world. Our leadership did not always measure up to the challenges it faced. Our initiatives were sometimes tardy and were often more limited than they should have been. But through 1972 one could say that the arms control process had a modest momentum. One could even hope that disarmament might some day overtake what has been called the mad momentum

of the arms race itself. Since mid-1972, however, arms control has slowed to a crawl. The informed public here and abroad is puzzled and concerned by this immobility. There are examples in each of the diverse areas of arms control. Some of these situations are, in fact, clearly more urgent than weather modification. But weather modification is a characteristic and rather striking case. I would draw particular attention to the failure of the Administration to level with Congress and the public; its failure to state its position clearly and frankly to the Congress or in international forums; and its failure to present the facts to the public so that we can assess all the arguments pro and con on a sound basis. The verbal smokescreens which Administration policy requires its witnesses to direct at inquiries such as this do not enhance the reputation of the United States and run counter to the basic principles of representative government.

I would like to close with a suggestion for consideration by the Committee.

Environmental warfare is, I believe, analogous to biological warfare in that it is in the U.S. interest to lead the way by renouncing it totally, as a matter of policy. We have already done exactly this with climate modification. We should then urge others to follow our example and negotiate a treaty to make this renunciation a permanent element of international law. Unhappily, for Congress simply to urge this or any similar course of action on the Administration may not be particularly effective. It has recently been rather difficult for the legislative branch to get the attention of the Executive branch. Congress can, however, still pass laws. I urge a provision in future defense money bills prohibiting the use of any funds for military weather modification activities. This would be analogous to the provisions which the Congress wisely inserted for several years in defense legislation banning the use of any funds for the production of chemical weapons. (That, by the way, is another arms control area in which there is an inexcusable and inexplicable failure on the part of the Administration to act or to explain its lack of action.) If this suggestion is adopted and the Congress makes clear in legislation that it will not permit activities aimed at environmental warfare, then the Administration may be more disposed to move along the lines of Senate Resolution 71.

Senator PELL. Our next witness is Mr. Pierre St. Amand, Earth and Planetary Sciences Division of the Naval Weapons Center, China Lake, Calif.

We are delighted you are here. I have heard of you through the years and we tried to have you at our last hearings. You were then out of the country, and I am very glad you are here, now.

I read your testimony last night. It is quite long, so I was wondering if you would care to have it inserted in the record and digest it for oral presentation.

STATEMENT OF PIERRE ST. AMAND, EARTH AND PLANETARY SCIENCES DIVISION, NAVAL WEAPONS CENTER, CHINA LAKE, CALIF.

Mr. ST. AMAND. I would be happy to have it entered and just to discuss the details, if you would like.

Senator PELL. I think it would be helpful to me and also I think to the people who are here if you would highlight it for us.

Mr. ST. AMAND. Very good.

Briefly, you had expressed interest in the sort of things we were doing, so I took some trouble to outline the general nature of the research work we had done in the past and I want to say right off the bat that I am appearing here at your invitation. I did not solicit the invitation, but I am happy to come and talk, and I am appearing not as a Navy representative but as a private citizen, and I must say that I am a little bit biased, perhaps, because I am rather proud to be associated with the Navy and to some extent I consider myself part of it, in my business life at least, but, some of my views are probably

at variance with those expressed by officials of the Navy and the Department of Defense and I am going to discuss this as it appears to me.

BENEFITS OF SCIENTIFIC DEVELOPMENTS BY NAVY

The Navy has long had a tradition that good science of benefit to the Nation and to humanity as a whole helps us all. Among the very first oceanographic efforts may be counted the works of Mathew Fontaine Maury. The massive compendium of navigational lore by Nathaniel Bowditch has been credited with the saving of millions of lives and having made navigation less hazardous than it was in the days before it was written.

Astronomy as a whole has benefited from Navy interest in positional astronomy. Many advances in medicine and in other sciences have been supported by the Navy and this information has been shared with us all.

It is not surprising therefore that the Navy, which has had to cope with the exigencies of the elements for its very survival at sea, should find weather modification a subject worthy of support. It is true that the Navy and the other Armed Forces stand to benefit from the science that they have developed. It is equally true that humanity at large has benefited from such work.

WORK AT NAVY WEAPONS CENTER

The story of our work at the Navy Weapons Center, formerly the Naval Ordnance Test Station, is an outgrowth of this policy. It was not a deliberate venture on the part of the Navy at the outset, but instead was the outcome of a concatenation of circumstances and abilities to be found at no other single place in the country.

In 1957, Dr. William Finnegan and Dr. Lohr Burkart, of the chemistry division of the research department, were involved in the development of colored smokes that produced highly visible clouds to be used as markers at high altitudes.

One of the techniques to produce such a smoke consisted in using lead iodate to oxidize an organic fuel so that lead iodide and free iodine were produced. This scheme resulted in a brilliant, reddish-violet smoke.

Ancillary to this work they prepared a mixture that, upon combustion, produced silver iodide. They had heard of the use of silver iodide in cloud seeding, and living in an area where rain was a novelty, they were quite aware of the potential usefulness of their technique. They told me about it and we set about learning about cloud seeding.

As it turned out this approach was more important than we realized at first, because, theretofore, cloud seeders had been using a substance similar to, and derived from, silver iodide but which was not silver iodide. Silver iodide is used to cause supercooled water to freeze. If a substance is to catalyze the growth of ice, it must not dissolve in water before the water has time to freeze.

Silver iodide is relatively insoluble, and because it has a molecular structure similar to that of ice, it is a good material to cause liquid water to freeze. In those days, clouds were seeded by use of an acetone burner that produced, instead of silver iodide, a complex of silver iodide and one of several alkali iodides. It was not generally realized

that the product of this device was not silver iodide but another compound quite different in its physical properties.

The exhaust products were water soluble and did not function as silver iodide was expected to do. This meant that people who were seeding clouds with the older system did not do what they thought they were doing. Indeed, in many elaborate experiments, based on the premise that clouds were being seeded with silver iodide, the clouds were not being seeded at all, or were being seeded in a manner different from that postulated.

This single fact led to most of the confusion that has developed as to the effectiveness of cloud seeding.

Most of the disagreement that is still to be found in academic circles is based upon this difference. The matter is now pretty well cleared up and the way is open to conduct a new set of efforts that could clearly demonstrate the effectiveness of cloud seeding under different meteorological conditions. Indeed, this is now being done by several agencies but at a level of support that is inadequate to the problem.

We soon became aware of this problem, and with the understanding that silver iodide could be produced in relatively pure form, in the right particle sizes and in the correct amounts and that it could be emplaced in clouds at the right time, we went ahead and developed a cloud seeding system based on the use of pyrotechnics. We then tested a slightly different solution to be used in acetone burners that did indeed produce silver iodide. (This concept had been elucidated in 1949 by Dr. Bernard Vonnegut, the inventor of the acetone burner, but had been ignored.)

We were able to do this because the necessary talent for the research and development, indeed, a unique combination of chemists, physicists, engineers, pyrotechnic specialists, meteorologists, and aviators, the necessary equipment and an enlightened management were all to be found in one place. A good deal of this work was supported by the Bureau of Reclamation and much of it was done in connection with the Department of Commerce for Project Stormfury.

The task of optimizing the system was lengthy. It was necessary to review, and in part correct, the theory of catalysis as applied to the freezing of water. We had to determine the correct particle size of the nucleant. We had to determine the right amounts. The solubility of silver iodide and other nucleants had to be considered and their rates of solution taken into account. New nucleating materials that worked at higher temperatures were developed. The materials and devices were tested in clouds over our ranges and over the southern Sierra Nevada. Samples of our seeding devices were sent to university groups and to other Government agencies, so that tests might be conducted by others under realistic conditions.

EXPERIMENTS CONDUCTED

For 2 years, we carried out experiments in the southern Sierra for the Bureau of Reclamation. Later we cooperated with them in an effort conducted by Fresno State College, to increase the snowpack and the rainfall in the central Sierra Nevada.

For 7 years we have been conducting, through a contractor, North American Weather Consultants, and with help from the Bureau of

Reclamation, a rainfall augmentation experiment in the Santa Barbara area.

The works has gradually passed from experiments with single clouds to whole groups of clouds and to components of storm systems.

Senator PELL. I read it last night.

Mr. ST. AMAND. I will highlight it to show you the extent of the work we have been involved in.

No untoward incidents have occurred and none are expected because of the care with which we have set up the experiments to preclude excessive precipitation as a result of our efforts.

AREAS INVESTIGATED BY NAVY WEAPONS CENTER

We are now engaged in study of a technique for slowing down portions of winter storms and thus changing their trajectory so that the rain along the Pacific coast of California might be spread out a little more equitably thus reducing the perennial drought in southern California and perhaps reducing the rain in the northern part of the State where it is usually too wet.

This we have not attempted to do; this is probably outside of our range of interest. I sincerely hope some other agency of the State of California or the Federal Government will take up where we started.

Part of our work has been dedicated to the modification of clouds too warm to be modified by the freezing process. For 3 years, we conducted experiments in the Brownsville, Tex. area. This effort was intended to produce more rain from these marginal clouds and to suppress the growth of these clouds, should that prove desirable.

Fog clearance has received the lion's share of our attention in recent years because of the need to remove small patches of fog and to clear aircraft landing areas. The use of hygroscopic seeding agents was systematically tried and developed to the point where, under the conditions at Arcata, Calif., it is possible to produce instrument minimums in a 1,000-foot thick fog 80 percent of the time and to produce an actual opening about 60 percent of the time. The technique is expensive and messy but does work well enough to be used in emergency situations.

Recently we have begun an investigation of the use of electrically charged particles as fog-clearing agents and are having promising results that indicate that it might be possible to clear fog with a greatly reduced logistic burden.

Prevention of fog formation by coating bodies of water with evaporation suppressants was tried with success in the Panama Canal. Improved methods of applying the evaporation suppressants have been developed by our chemistry division.

We have done limited work in fog formation and intensification. This system uses an aerosol consisting of common salt made more hygroscopic by the addition of small amounts of potassium and lithium chlorides. With these it is possible to create an overcast condition and to make small cumulus clouds under the right meteorological conditions. In the amounts needed to stabilize or to create fog, the materials are not toxic, are less corrosive than sea spray and far less harmful than conventional screening smokes.

Our work has been to some utility to the rest of the world.

The fog prevention work in Panama is being tested to see if it is possible to relieve the obstruction to navigation that occurs at night during the rainy season in the Gaillard Cut of the Panama Canal. If the tests being undertaken continue as well as they have, this method will prove useful in permitting uninterrupted flow of traffic through the canal, thus aiding world commerce. The techniques of applying the evaporation suppressants will no doubt become widely used commercially and will prove of benefit in applications where ranchers and others have, for a long time, used evaporation suppressants to conserve water in small reservoirs and stock ponds.

DROUGHT RELIEF EFFORTS

On several occasions, the resources of the U.S. Military Establishment have been called upon to take action against droughts in various parts of the world. In 1967, a small group of private contractors directed by the Naval Ordnance Test Station was sent to India to help with a devastating drought in the Bihar and Uttar Pradesh Provinces.

Over a period of about 3 months, in the middle of the dry season about 100 clouds were seeded with air dropped pyrotechnic units. These clouds, most of which were not raining to begin with, yielded from one-quarter to one-half inch of rain. The drought was so far advanced, and the clouds so few, that this effort was not enough to materially affect the drought. It did show, however, that properly planned and conducted at the right time of the year, cloud seeding could beneficially aid that country in its agricultural efforts.

In 1969, a drought relief effort in the Philippines was conducted by the United States, using Air Force aircraft and crews and technical personnel from the Naval Weapons Center.

This effort was remarkably successful, because clouds, that were in general too small to rain by themselves, were caused to grow and rain abundantly. It was estimated by the Philippine government that at least \$60 million in additional foreign exchange was developed by agricultural use of the rain resulting from the cloud seeding. In addition, another \$25 million was saved because it was not necessary to import corn and rice.

The following year, the Philippine Sugar Institute led an effort using a U.S. contractor and Philippine pilots who had been trained the previous season by our personnel.

This effort met with the same sort of success and the capability to seed clouds has been retained and augmented.

In 1971, we were called upon to help the Island of Okinawa, then under U.S. military control. A protracted drought had reduced the water shortage on the island to inadequate proportions and the populace was subjected to severe water rationing.

The U.S. Navy made available the services of the antisubmarine patrol squadron at Naha, and we furnished technical direction for a period of a few weeks. Here, the skills developed by the patrol squadron in tracking ships and submarines made it an easy matter to select clouds at sea whose trajectory would lead them over land and to estimate the time of landfall of the clouds. The clouds so selected were seeded at sea, caused to grow and kept alive until they came within 10 minutes of landfall.

Senator PELL. I don't mean to hurry you but it would be about 40 minutes if you read the whole statement.

I was wondering if you could highlight your points with regard to the treaty and also the potential use of this.

CENTER'S RESEARCH AND DEVELOPMENT SHARED

Mr. ST. AMAND. All right, I will do that. I am trying to make clear that our research and development has not been self-contained, that we shared it freely with the rest of the world as they have asked for it and with other agencies of the U.S. Government and with private concerns.

We receive correspondence every month from people in some foreign country who would like to get a little advice or learn something about how to do it, and we always carefully answer the letters and so forth.

OK.

Senator PELL. Along this line, then, you share freely with other countries. Did your laboratory have any relationship with the weather modification in Southeast Asia that was reported in the press?

Mr. ST. AMAND. I am appearing here as a private citizen. I am not authorized to express any opinions whatsoever one way or the other on the subject, gentlemen. I must decline to answer.

Senator PELL. Thank you. I was just following up your statement that you shared your knowledge with all other nations; if that was so, I was wondering if we shared it in Laos and South Vietnam as well. But I know the restrictions under which you are operating, so we will move on to your comments.

USES OF ENVIRONMENTAL CONTROL

Mr. ST. AMAND. OK. It has been suggested the control of the environment would constitute a truly horrible weapon of war. If one could do all the things that the proponents of restricting the use of geophysical weapons imagine could be done, this might be true.

As it is, one can only make rain, clear fog, and reduce hail at the present time. On a tactical scale, this technology—I am talking about a small scale where you have your groups committed, and small areas, you must do something to help them—could be very useful to the United States and would not constitute a threat to the climate of the world.

The potential exists that over the years, the applications of geophysics to warfare could become a very important military tool. I am considering this primarily in a tactical sense.

No one can, at present, influence earthquakes in any appreciable way. It is true that small earthquakes have occurred as reservoirs were being filled, and in a few instances appear to have been caused by underground pumping. These techniques hold no promise for any deliberate use in controlling such phenomena, nor can I envision any techniques for producing or influencing earthquakes one way or the other.

EARTHQUAKE CONTROL

Senator PELL. Is that as of now or do you visualize the technique cannot be developed?

Mr. ST. AMAND. If you want to get an answer that is wrong ask a scientist what can't be done, but I don't think that within our century any progress can be made in controlling earthquakes. By understanding the nature and mode of occurrence of earthquakes and the application of sound engineering and good construction practices, the threat of earthquakes can in a few decades be abated.

Tsunamis are caused by large earthquakes. There is no way to produce true tsunamis. Even if there were, a tsunami would not affect installations more than a few hundred yards of the shoreline. Tsunamis would not be a useful weapon because they radiate over the whole ocean and would cause extensive damage to friendly coasts as well.

Changes in ocean currents are possible to attain with protean efforts. One could perhaps dam the Bering Straits or divert the Gulf Stream. Such an effort would require the cooperation of a large part of the world and would present such unforeseen consequences that it is unlikely that it would, or could, be done unilaterally by any civilized nation.

WHY TREATY IS NOT NEEDED

I, therefore, feel that such a treaty addresses things that cannot be done now, are extremely unlikely in the next century, probably wouldn't be done in any case, and are therefore premature.

A treaty to preclude generic use of geophysical weaponry as could be used to cause damage in excess of that necessary for the attainment of the objective is not needed, because we are already morally and, in effect, legally bound to do as the treaty would say.

We would, if no such treaty existed, not be bound to forego the use of an advantageous system were that system to be used effectively in the protection of our own forces, people, and property. One must consider, in proposing such a treaty, whether the use of any weapon or device whatsoever to protect a fighting force does in itself constitute an act of war.

DISTINGUISHING BETWEEN PEACEFUL AND WARLIKE USES OF WEATHER MODIFICATION

To my mind anyone who does anything in support of his government, or economy, in a time of war is a member of the fighting team and is participating in war. If this be so, how can we distinguish when an act is performed if it will be in violation of the treaty?

The complete barrier to all such work as proposed in the treaty could moreover work unnecessary hardship on our defense forces. For example: Would it be proper to clear fog so that our warplanes could safely return from combat? Would it be proper to clear fog so that they could launch a mission? Would it be proper to clear a target area so that they could strike the enemy?

All of these would appear to be proscribed. It might also be improper to clear fog for any purpose whatsoever, if the persons whose work was facilitated by such clearance could more effectively aid the military effort of their country.

Some distinction should be made that is not now made in the proposed treaty, or the United States may have to deprive itself of the enjoyment of such advantages as might flow from peaceful use of

weather modification, if it were done in time of war to augment food or energy supplies so that the war could be more effectively fought.

TECHNOLOGY TO AID OUR TROOPS, NOT HURT ENEMY

Weather is a terrible problem to the Navy and to a lesser extent the Air Force. To the Army and the Marines the weather is a serious factor that must always be contended with and which often decides the outcome of military contests. There are situations wherein the technology would not be used in actual combat to hurt the enemy but might greatly aid our own troops while engaged in a war.

Excessive fog could prevent resupply as it did in the Battle of the Bulge. The American troops were short on food, ammunition, and fuel, and were unable to advance. This advance was critical to obtaining the fall of Germany while the Wehrmacht was still reeling from earlier reverses.

A portion of the time this fog was supercooled. Available techniques can now, with a very high reliability, clear supercooled fog in a matter of 30 or 40 minutes. It would have shortened World War II by several weeks if the technology had then been available. Would it have been wrong to use the technology? I think not.

Tank and infantry warfare is dependent upon a fairly hard surface for the mobility of troops and equipment. Were a situation to arise in which by increasing rainfall, one could decrease the trafficability to such a point that the efforts of the enemy to attain an objective were thwarted or delayed until we could prepare for a confrontation, would we be justified in using weather modification? I think so.

WHETHER GEOPHYSICAL WARFARE WOULD CONSTITUTE CRUELTY

On the other hand, if there were no clearcut military target and the only outcome of one's action were to cause misery for the civilian population, and there were other ways of preventing men and material from reaching the front, then the use of such tactics would clearly be irresponsible in that damage would be caused without gaining any real advantage for oneself.

One must also address the question of whether or not geophysical warfare would constitute cruelty. All war is bad and counterproductive. Usually wars are fought with high explosives, projectiles and other products that have a deleterious effect on personnel. Would it be less cruel to immobilize an infantry company with excessive rainfall than it would be to burn them with napalm or destroy them with bombs? If they would be kept out of the fight and not be permitted to hurt themselves or others, would it not be better than killing them?

Another type of geophysical warfare that has two sides to it might be the manufacture of a long-term change in climate. Two sides, because it could be used to harm or to aid a potential enemy. Assume for the minute that a large country exists in which a nonirrigable crop must be planted and matured so that the country has adequate food and foreign exchange. It might, to take a negative viewpoint, be advantageous to cause heavy rain during planting season to preclude sprouting and growth and then to cause severe and protracted drought during the growing season.