

clearing fog at airports, now done routinely for "cold" fog at some places by the military, and at civilian airports. No long run or wide area effects have ever been reported. While aircraft are legally permissible in warfare, no country would presumably accept a ban on modifying airport weather to make flying safer, even though this might facilitate an increased number of missions. If one moves up from this one step further, should clearing the weather over the English Channel on July 4, 1944, had it been possible and of only temporary local effect, be conceived of as a crime? While use of high explosives, flame, smoke for screens, and other unpleasant techniques for controlling a battlefield are permissible, it seems difficult to justify banning the use, if it existed, of a modification technique for creating or clearing a battlefield fog or for wetting or drying out the contested terrain. Battlefield techniques which primarily improve the functioning and safety and efficiency of traditional combat weapons are likely to be used by the nations. And perhaps even on balance they are likely to cut down the toll of warfare, to save lives. There seems little obvious reason to attempt to ban them; and little hope of doing so effectively. Even where typical environmental modification techniques are designed for use primarily or exclusively against civilian populations, they do not appear to be potentially as dangerous or as irreversibly damaging as other similarly utilized weapons of mass total war. It has become traditional in this century to attack the supply lines of an army, right back to the factories and populations. Effective limitation of the use of all such weapons of mass destruction should be attempted. A revision of the rules of warfare seems overdue. However, it should be remembered that present rules do purport to protect civilian populations. If they are ineffectual that itself is a lesson, a warning to seek for causes. And it must be further recognized that the twentieth century high technology all-out war has brought the distinction between civilian farm and factory worker and fightingman itself into question. Unless and until conventional warfare itself can be credibly limited to the military contestants it does not seem inherently more criminal to induce rain to fall on civilians rather than bombs. Indeed it seems more humane.

On the other hand, mass privation caused by enemy induced drought might well be more widespread than privation even by such more traditional weapons as blockade, pillage or siege. Even in such cases it seems probable that any such attempts to induce drought or otherwise destroy crops would be counteracted by responsive weather modifications or other counter measures so far as possible. For, as noted, the technology, even as it improves in reliability, seems likely to remain relatively simple, broadly understood, and generally available to poor as well as rich states. Nevertheless it seems reasonable to draw the necessarily arbitrary line somewhere near here between environmental modification techniques which can be classed realistically as new versions of traditional, limited weapons of war and which insofar as they yield temporary, reversible, limited modifications can be expected to remain quite legal; and those new weapons of irreversible or large scale environmental change which often can be used to indiscriminately damage whole populations and which might well be outlawed, in principle at least, by treaty.

(b) To the extent that the treaty would take the military completely out of research in weather modification, it seems too broad. First of all we have suggested that some environmental modifications be permitted as possibly more humanitarian—and no worse than other conventional means of warfare. These would have to be developed and tested by the military. In addition it seems doubtful that, with its present broad wording, the treaty could be accepted by the Soviet Union, where the military fire the shells and rockets in civilian hail suppression programs for example, or in the United States, for that matter where the military have been called on to lend planes and equipment to drought relief programs (in Texas), and have provided support for other primarily civilian research programs such as Project Stormfury. They have in general worked with civilians of this and other countries in learning about severe storms, fogs, etc., they have developed new modification technology of general utility, for example, silver iodide delivery systems which others can use, in addition, one supposes, to pursuing some forms of "classified" research.

Weather modification is indeed another area in which it is difficult or impossible to segregate "militarily useful" from "civilian" research. Cloud studies, seeding techniques, everything, seem equally useful to weather prediction or flying and to both military and civilian pursuits. Thus, unless equivalent funding sources were made available to "civilian" modification research, and research in this field has in fact been cut back recently, removing the military from all research would probably slow the development of techniques for peaceful uses. Moreover, in the

absence of a secure enforcement system, even if a treaty banning use of any major "weather weapon" were adopted, it might well appear essential to those concerned with national security and international stability to continue to permit carefully devised military or civilian research on the development elsewhere of modification and/or counter-modification techniques. Even these programs should be designed to avoid major wide-scale research in nature until it is clearly safe and acceptable to all importantly affected parties. Thus some system of organized consultations and reporting seems in order even for nations which feel they must continue research to keep abreast of the technological possibilities and to maintain a capacity to detect and to counter potential major modifications or weather switches threatened by a non-party or a treaty violator, if such maneuvers became feasible. At minimum any damages caused to others from operations or experimentation without their consent should regularly be compensated for efficiency reasons as well as for equity. How to assure that military research units conform to acceptable group standards of environmental safety and responsibility, etc., however, remains a significant problem—not well resolved even within states like the United States and even more difficult at the international level. We do not mean to gloss that over. Surely it should be explored more than it has been before an indiscriminate "ban everything new" strategy is adopted.

Thus while supporting an approach now to preventing weather modification from becoming a new source of major conflict, we believe that the presently proposed draft treaty goes too far in an effort to bar military usage of potentially life saving, or at least inherently no more deadly, substitutes for other legal weapons in limited and small wars. At the same time it does not cope with the major problems these technologies raise—weather switching—intended or not—for peaceful uses which damage others and which would tend to be at least as harmful to the world's environment and more destabilizing to the peace than a major use in wartime. The proposed treaty needs major revisions, in our judgment, both to be more creatively useful to the security of the human community, even in its present state of development, and to have some chance of acceptance by the nations.

This brings us to the position of those who support all small steps to disarmament as "steps in the right direction." Our position is to pursue this strategy only when it appears on balance to yield a net move in the right direction; after considerations of self-defense and systemic balance are elucidated. Our nation and our world must not be exposed to substantial risks or the suggestion is probably a step in the wrong direction. Two dangers of such a "ban everything as soon as you can" strategy are (1) that even if successful, it does not eliminate war or the causes of war; nor does it limit the use of historically the most popular lethal weaponry—even of mass impact. It may therefore regularly be expected to eliminate the more humane new weapons along with the more deadly ones, in favor of continued use of those which have historically the most successful wartime applications. (2) Even more important such a strategy may repeatedly delude people into thinking they have definitively denatured the dangerous implications of a new technology, when they have not at all even attempted to cope with the major problems which it poses for society. We hope our discussion has pointed out some of both types of fallacy.

We do not think this is a bad thing if properly redrafted to permit restricted humanitarian-weather modifications and conventionally limited uses in wartime of these techniques. It even has the traditional escape clause so that states can always seek self-defense as they always have, by loosening any restrictions which seriously inconvenience them on balance in their pursuit of survival on their own terms. We think this is not enough, and because it is so very little, it therefore poses a substantial danger of being a fraud-of fooling people-of lulling them into believing that the major political dangers potentially implicit in the development of useful weather modification technology, for instance, for changing the status quo of nature in ways that traditionally have led to wars, have been coped with when they have not. Not at all. This proposal then is only a small partial step towards assuming that these new technologies will not induce Armageddon. This little step is likely to be far from enough, though on balance, if improved, it is not likely to be a step in the wrong direction.

We could endorse a proposal of this type, modified as suggested herein, as generally in the self interest of the United States so long as this is understood, since it should, among other things, facilitate the control by the Big Powers of the numerous countries, large and small, which will share these new technologies with

their potential for dangerous conflict. This promises on balance to be a legal convenience, but it is not likely to be an important achievement in neutralizing the major potential hazards to world peace and survival potentially implicit in these new technological achievements. How to do this optimally still deserves our primary attention.

[Whereupon, at 1 p.m., the subcommittee adjourned, subject to the call of the Chair.]

## WEATHER MODIFICATION

WEDNESDAY, MARCH 20, 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 2:30 p.m., in room S-116, Capitol Building, Senator Claiborne Pell [chairman of the subcommittee] presiding.

Present: Senators Pell and Case.

Also present: Dr. Pierce S. Cordan, U.S. Arms Control and Disarmament Agency.

Senator PELL. Gentlemen, I think we might as well get started. Some of my colleagues will be coming in, but I think it is important to get on with this meeting today and lay out the record.

Why don't you introduce yourselves and then proceed as you will, after which I have a series of questions.

**STATEMENT OF DENNIS J. DOOLIN, DEPUTY ASSISTANT SECRETARY OF DEFENSE (EAST ASIA AND PACIFIC AFFAIRS); ACCOMPANIED BY MAJ. GEN. RAY FURLONG, USAF, DEPUTY ASSISTANT SECRETARY OF DEFENSE (LEGISLATIVE AFFAIRS); LT. COL. ED SOYSTER, USA, ORGANIZATION OF THE JOINT CHIEFS OF STAFF; COL. ALBERT J. KAEHN, JR., O.D.D.R. & E.; AND WILLIAM CHAPIN, BUREAU OF INTERNATIONAL SCIENTIFIC AND TECHNOLOGICAL AFFAIRS, DEPARTMENT OF STATE**

Mr. DOOLIN. Thank you, Mr. Chairman.

I am Dennis Doolin, Deputy Assistant Secretary of Defense for East Asia and Pacific Affairs. This is Maj. Gen. Ray Furlong, Deputy Assistant Secretary of Defense for Legislative Affairs, and Lt. Col. Ed Soyster of the Office of the Joint Chiefs of Staff, who will be your briefer today. If it meets with your approval, I propose that Colonel Soyster will give the briefing.

Colonel Soyster.

Colonel SOYSTER. The purpose of this briefing is to provide information on the only DOD classified weather modification activity—this being our rainmaking in Southeast Asia.

[Chart 1 follows:]

CHART 1

# SEASIA RAINMAKING

[SUPPLIED BY DEPARTMENT OF DEFENSE]

**A CLASSIFIED RAINMAKING PROGRAM WAS CONDUCTED IN SEASIA FROM 1967 TO 1972 WHICH EMPLOYED AIR DROPPED SILVER AND LEAD IODIDE SEEDING UNITS TO INCREASE NORMAL MONSOON RAINFALL.**

## PURPOSE OF OPERATIONS

Colonel SOYSTER. The purpose of this operation was to make difficult the North Vietnamese infiltration through the Laotian panhandle and Plain Des Jarres.

## EFFECTS OF NORTHEAST AND SOUTHWEST MONSOON SEASONS

This area of Southeast Asia has two principal seasons—the northeast monsoon and the southwest monsoon.

During the northeast monsoon the rainfall is light or nonexistent and even unimproved roads are unaffected by the limited rains. During the southwest monsoon the rainfall is heavy and almost daily. As a result, the unimproved roads in this region become soaked and will not support vehicular traffic. From the beginning of our efforts in Southeast Asia, operational personnel would rely on the coming wet season brought by the southwest monsoon to contribute greatly to the enemy's logistic difficulties.

The close monitoring of troop and truck traffic along routes where rain had fallen verified beyond any doubt the naturally adverse effects of rainfall and accumulated soil moisture on the enemy's logistic effort. From April to mid-May, as the spring transition to the southwest monsoon occurs, it was found that even isolated thundershowers temporarily interrupted logistic operations. Most unimproved vehicular route surfaces are hard due to the relatively dry weather conditions that prevail in Laos during the northeast monsoon. When intermittent rain falls on this kind of surface, runoff is quick and virtually complete. However, as both the amount and frequency of rainfall increases—this is from the period of May through June, the ground begins to soak up more and more moisture until it becomes saturated. When this condition is created, the

ground remains "soggy" for extended periods with only moderate amounts of rain needed to maintain saturation. At this point, vehicular travel becomes extremely difficult if not impossible. Typically, by the end of June, the southwest monsoon is well established and soil moisture has reached the point where roads remain soggy. These conditions continue through September. The fall transition to the dry northeast monsoon then begins with less rainfall in the area.

#### OBJECTIVE OF PROGRAM

The program was to increase rainfall sufficiently in carefully selected target areas to further soften the road surfaces, cause landslides along roadways, and to wash out river crossings. These events normally and naturally occur anyway during the height of the rainy season. By seeding it was intended to extend the period of occurrence beyond the normal rainy season and to supplement the natural rainfall as required to maintain the resultant poor traffic conditions.

[Chart 2 follows:]

#### CHART 2

## OBJECTIVE

[SUPPLIED BY DEPARTMENT OF DEFENSE]

**INCREASE RAINFALL SUFFICIENTLY IN CAREFULLY SELECTED  
AREAS TO DENY THE ENEMY THE USE OF ROADS BY:**

- (1) SOFTENING ROAD SURFACES**
- (2) CAUSING LANDSLIDES ALONG ROADWAYS**
- (3) WASHING OUT RIVER CROSSINGS**
- (4) MAINTAIN SATURATED SOIL CONDITIONS  
BEYOND THE NORMAL TIME SPAN**

#### TECHNIQUE USED

**Colonel SOYSTER.** The technique that was used takes advantage of an important natural process that causes rainfall in cumulus clouds in the tropics. In this natural process when a strong temperature inversion exists, clouds frequently grow to the level of the inversion and only occasional turrets succeed in rising to greater heights.

**Senator PELL.** What is an inversion?

**Colonel SOYSTER.** Normally temperature goes from a warmer to a colder condition as you rise in altitude. In an inversion it is reversed, that is the cold air is on the bottom.

As the turret passes the inversion, it rises first through slightly warmer air and then into a colder, much drier region. As the turret reaches its apex and begins to cool larger droplets of moisture begin to form and the previously white clouds begin to darken and descend into

the mass below the collapsing portion of the cloud. The falling drops grow by condensation for a short while because they are colder and then by collision with the underlying, smaller, more slowly falling droplets. The techniques employed, which I will describe next, accentuate this natural process by causing cloud growth with subsequent collapse. In many respects, effective seeding of a marginal convective cloud is akin to bringing a banked furnace to life. With this in mind, let me now describe the technique used.

In general, cloudseeding involves locating updrafts in clouds and releasing small amounts of seeding material into the updrafts. The seeding agent causes supercooled drops to freeze, releasing energy (heat) and a more rapid condensation of water vapor on the frozen drops than is possible on the liquid droplets, with, of course, the accompanying faster release of energy. Clouds appear to operate at near equilibrium conditions and even a small change in energy release causes a change in updraft velocity, heating makes the air rise faster and the updraft area and velocity is increased, sucking in more moist air from below and causing condensation throughout the ascending column.

This chart illustrates the air flow. As shown at (A), rapidly growing towers frequently develop a pileus, or small cloud directly above the updraft. This is a good indication of updraft position. Air comes in the bottom of the cloud, flows up through it, past the visible top and down around the sides, much like a bubble fountain. A downdraft surrounds the sides of the clouds, at least at seeding altitudes.

At (B)—Following seeding, the central portion rises rapidly and the base widens. Usually, the portion above the freezing level doubles in volume in 3 to 5 minutes. Updrafts inside are intensified, the total downdraft external to the cloud increases.

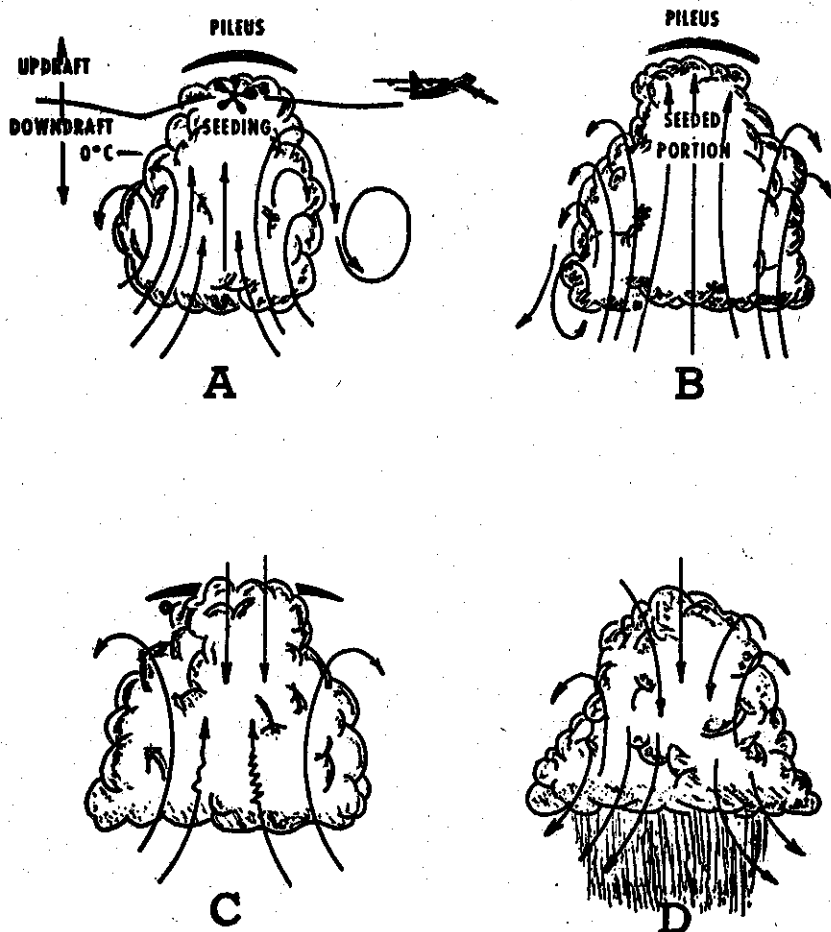
Turning to (C)—At apex, the cloud ceases to grow vertically, the top begins to evaporate and begins a gentle descent into the mass beneath, where the droplets run into still ascending air carrying cloud water upward.

And finally at (D)—A rain shower develops as the cloud collapses. The sequence closely resembles a typical rain shower process in the tropics, except that the presence of ice, which the seeding has caused to form in the process is not natural in tropical rain showers.

[Chart 3 follows:]

### CHART 3.—Cloudseeding Technique

[Supplied by Department of Defense]



### SEEDING UNITS AND TECHNIQUE

Colonel SOYSTER. The seeding units used to seed were developed at the Naval Weapons Center, China Lake, Calif. and are not classified. The seeding units and technique are identical to those used in publicized rainmaking projects—for example, Philippines, Okinawa, Texas—and the Stormfury research project.

The seeding units consist of a 40 mm aluminum photoflash-type cartridge case with primer and a candle assembly. The candle assembly includes a plastic container 3 inches long with the seeding material and necessary delayed firing mechanism to ignite the free falling container. The silver iodide or lead iodide is produced as the chemical mixture burns.



The burning time is about 36 seconds for the most commonly used type. The unit drops about 3,000 feet during its functional burn. The units are dropped inside the cloud in the active updrafts at intervals of approximately one-half mile.

The release is normally controlled by the pilot flying the aircraft who can best determine the location of the updrafts. Two types of aircraft were used—the WC-130 weather reconnaissance aircraft and the RF-4C reconnaissance aircraft. The WC-130 carried pods containing 104 units each on both sides of the aircraft fuselage just forward of the paratroop jump door. The RF-4C carried a total of 104 units in the photo cartridge compartments. Typically, these aircraft could influence an average of 4-5 clouds or groups of clouds per day during the southwest monsoon.

The technique requires that specific individual clouds be seeded. Their growth is related to atmospheric conditions and the amount of seeding so that when the seeding ends, the thunderstorm created acts like any other storm and is short-lived because the seeding materials either rain out, disperse, or decompose.

#### REQUIREMENTS FOR AND EFFECTS OF FAVORABLE SEEDING

Over-seeding or improperly placed seeding tends to disperse the clouds. There is no chance of prolonged effects. Under nearly perfect conditions, effects last possibly 6 hours maximum. Normally, the effect is about one-half hour. Further, favorable seeding requires low velocity and unidirectional winds to prevent dispersal. The effects are therefore limited in area, perhaps 20-mile diameter under ideal conditions and continuous seeding where groups of clouds could be knitted together to form one large storm center. With this background in technique in mind, let me now turn specifically to our program.

#### 1966 PILOT PROGRAM

In 1966, the Office of Defense Research and Engineering proposed a concept of using these known weather modification techniques in selected areas of Southeast Asia as a means of inhibiting enemy logistical operations.

During October 1966, a scientifically controlled test of the concept and seeding techniques was conducted in the Laos Panhandle. The test was conducted under the technical supervision and control of personnel from the Naval Ordnance Test Station (now Naval Weapons Center), China Lake, Calif., using in-theater resources. Fifty-six seedings were conducted, and over 85 percent of the clouds tested reacted favorably. On November 9, 1966, the Commander in Chief, Pacific [CINCPAC] reported the test completed and concluded that cloud-seeding to induce additional rain over infiltration routes in Laos could be used as a valuable tactical weapon.

Intelligence analysis of the area indicated that there would be no significant danger to life, health, or sanitation in the target areas. The sparsely populated areas over which seeding was to occur had a population very experienced in coping with the seasonal heavy rainfall

conditions. Houses in the area are built on stilts, and about everyone owns a small boat. The desired effects of rainfall on lines of communication are naturally produced during the height of the monsoon season just by natural rainfall. The objective was to extend these effects over a longer period. It was neither necessary nor desirable to increase the total rainfall above the levels experienced during a normal heavy monsoon season. In fact, the normal variations in total annual rainfall were greater than the variations we could induce.

The operation was closely monitored and controlled. When reconnaissance indicated that objectives were attained in one area, the limited resources were shifted to other areas. Seeding was not conducted during periods of tropical storms when large amounts of rainfall were falling naturally and accomplishing the military objectives. It is the consensus of the scientific community that the techniques employed could not be used to create large uncontrolled storm systems accidentally or purposely.

Conversely, seeding to the extent conducted in Southeast Asia did not cause drought in neighboring areas. There is simply too much moisture in the air in that part of the world, and operations affected only a small percent of it—probably less than 5 percent. The desired effect was simply to control where that small percentage fell to the ground.

#### OPERATIONAL PHASE

With the success of the pilot program and the considerations just presented, the operational phase began on March 20, 1967, and was conducted each subsequent year during the rainy southwest monsoon (March–November) until July 5, 1972.

Senator PELL. Would you repeat that sentence?

Colonel SOYSTER. Yes, sir. After the successful pilot program and the considerations I just presented, the operational phase began on March 20, 1967, and was conducted each subsequent year during the rainy southwest monsoon; that is the period March through November until July 5, 1972, when we flew the last mission.

The program was authorized three WC-130 and two RF-4C aircraft with associated crews and maintenance personnel. These aircraft provided two WC-130 and one RF-4C sorties per day, when required. However, these aircraft, which operated out of Thailand, were not dedicated exclusively to the cloudseeding missions. The WC-130's also conducted tropical typhoon reconnaissance and tactical weather reconnaissance support missions. RF-4C's performed regular photo reconnaissance missions. The annual cost of the total program was approximately \$3.6 million covering operation and maintenance, temporary duty pay, and seeding materials.

#### AUTHORIZED AREAS OF OPERATIONS

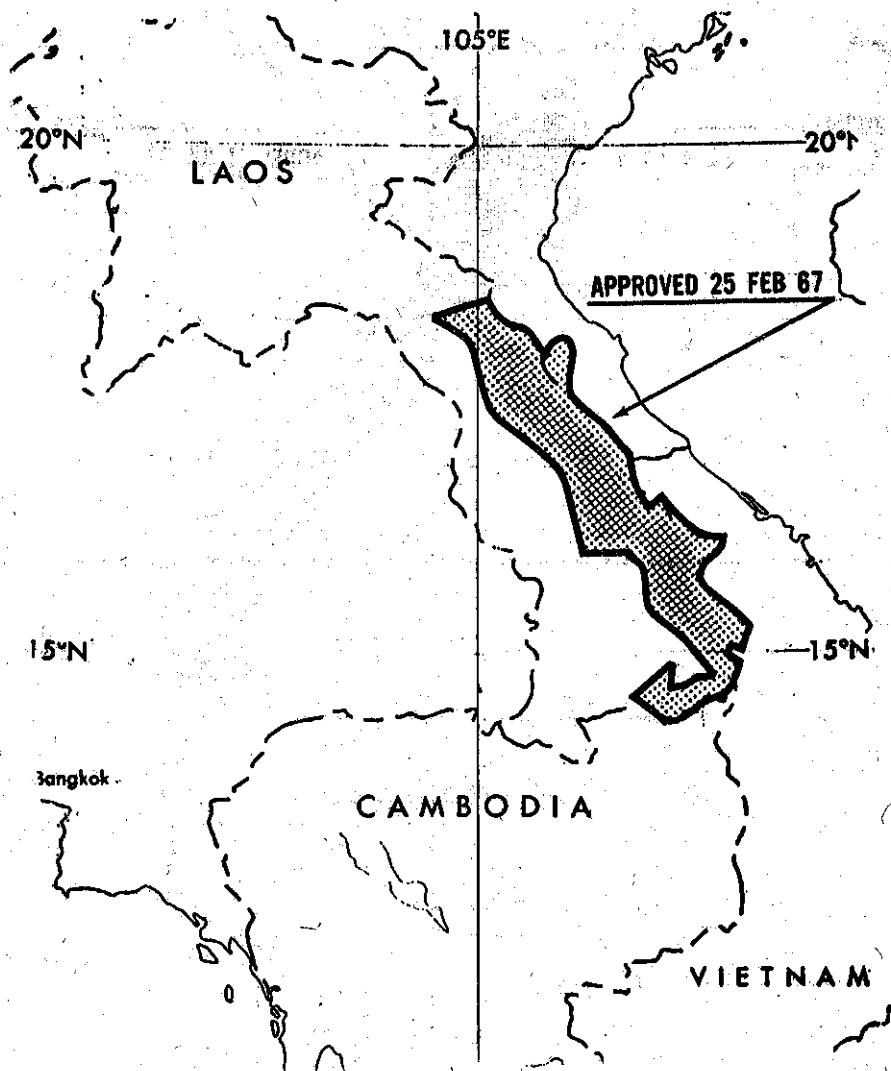
In answer to the question "Where was it done?" I will now show the authorized areas as they developed chronologically with sortie rate and amount of seeding expended.

This map illustrates the area initially authorized for operations in Laos and a very small portion of North Vietnam.

[Chart 4 follows:]

CHART 4.—Initially authorized area of operations.

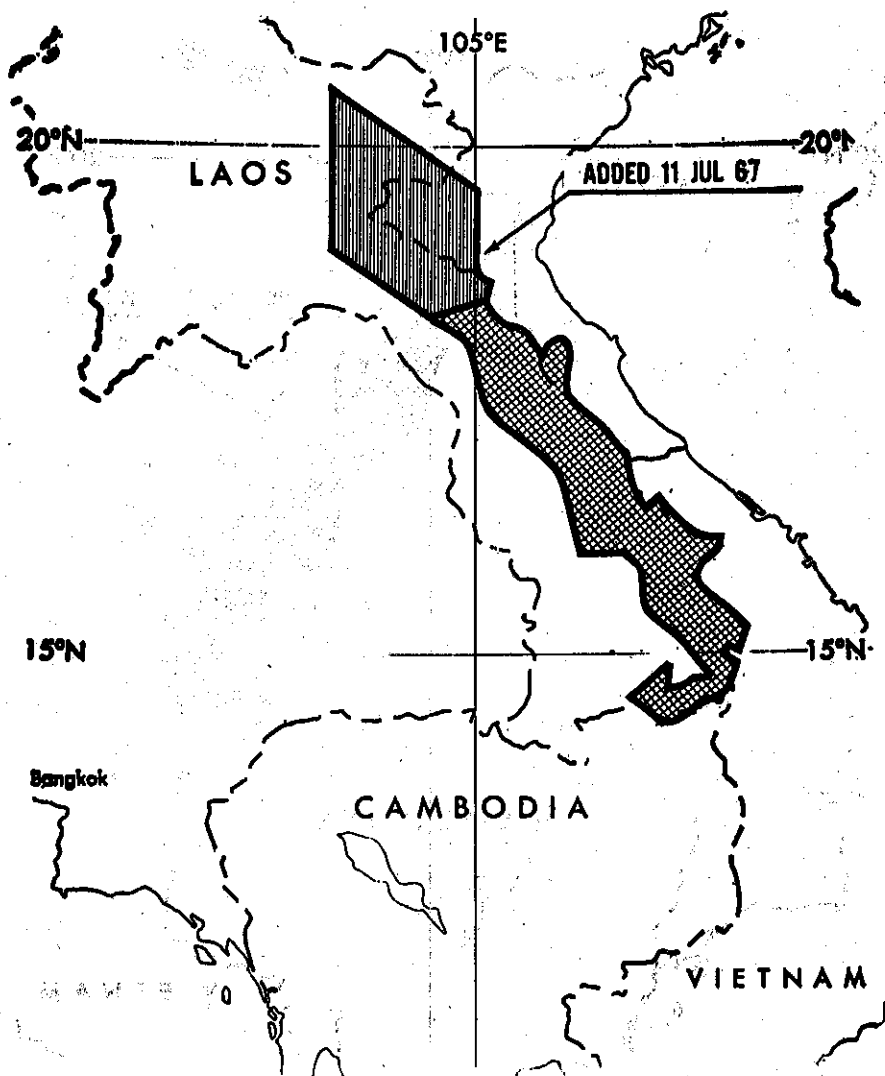
[Supplied by Department of Defense]



Colonel SOYSTER. An area encompassing additional portions of Laos and North Vietnam was added on July 11, 1967.  
[Chart 5 follows:]

CHART 5.—Additional area of operations authorized on July 11, 1967.

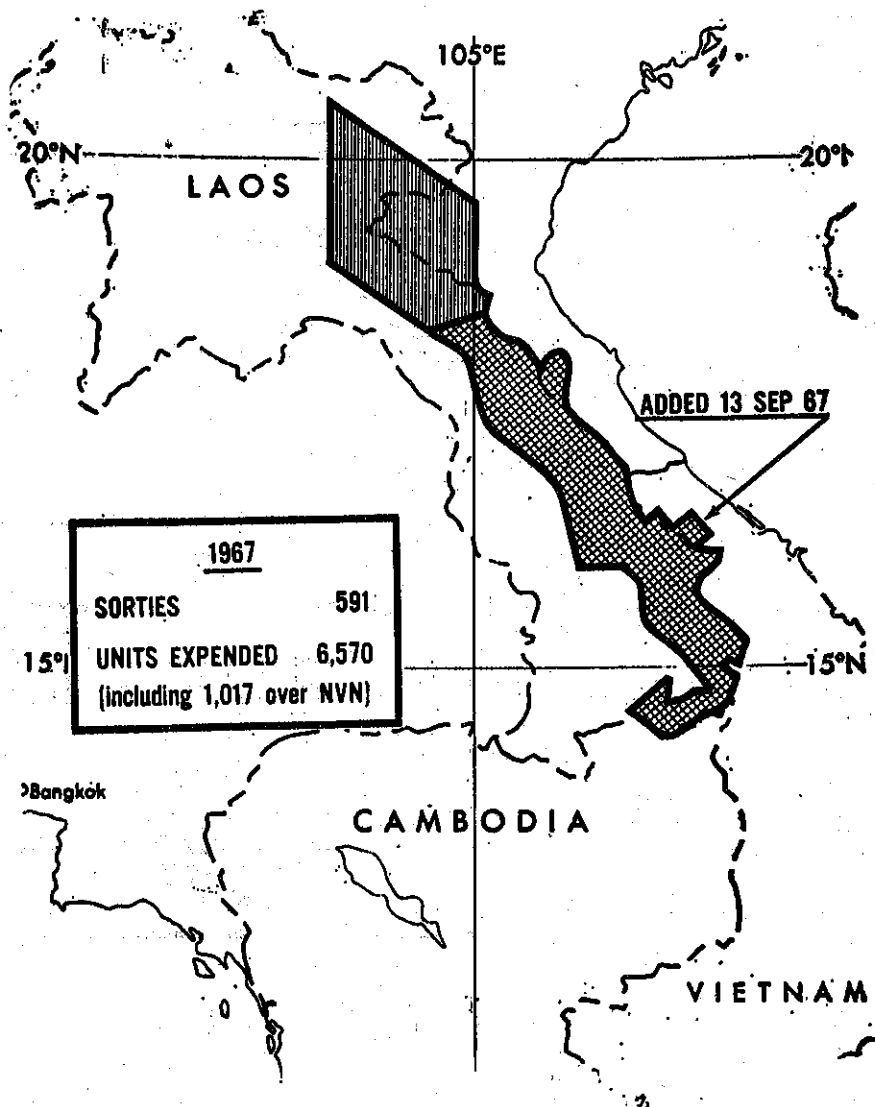
[Supplied by Department of Defense]



Colonel SOYSTER. Finally, a small area over the A Shau Valley in South Vietnam was added on September 13, 1967. The chart also shows the total sorties flown and the units expended for 1967.  
[Chart 6 follows:]

CHART 6.—Area of operations added on September 13, 1967, and sorties flown and units expended for 1967.

[Supplied by Department of Defense]



Senator PELL. The units expended.

Colonel SOYSTER. Yes, sir; the number of 40 mm photoflash-type cartridges, as I have described, which were expended. We expended

1,017 over North Vietnam. The total sorties include both WC-130 and RF-4.

Senator PELL. Looking at the picture the concentration was more on North Vietnam, six of the units in those two small spaces. I see it would add up about the same.

Colonel SOYSTER. Yes, sir. Of course, these were expended over specific clouds over certain trails which I will talk about a little later.

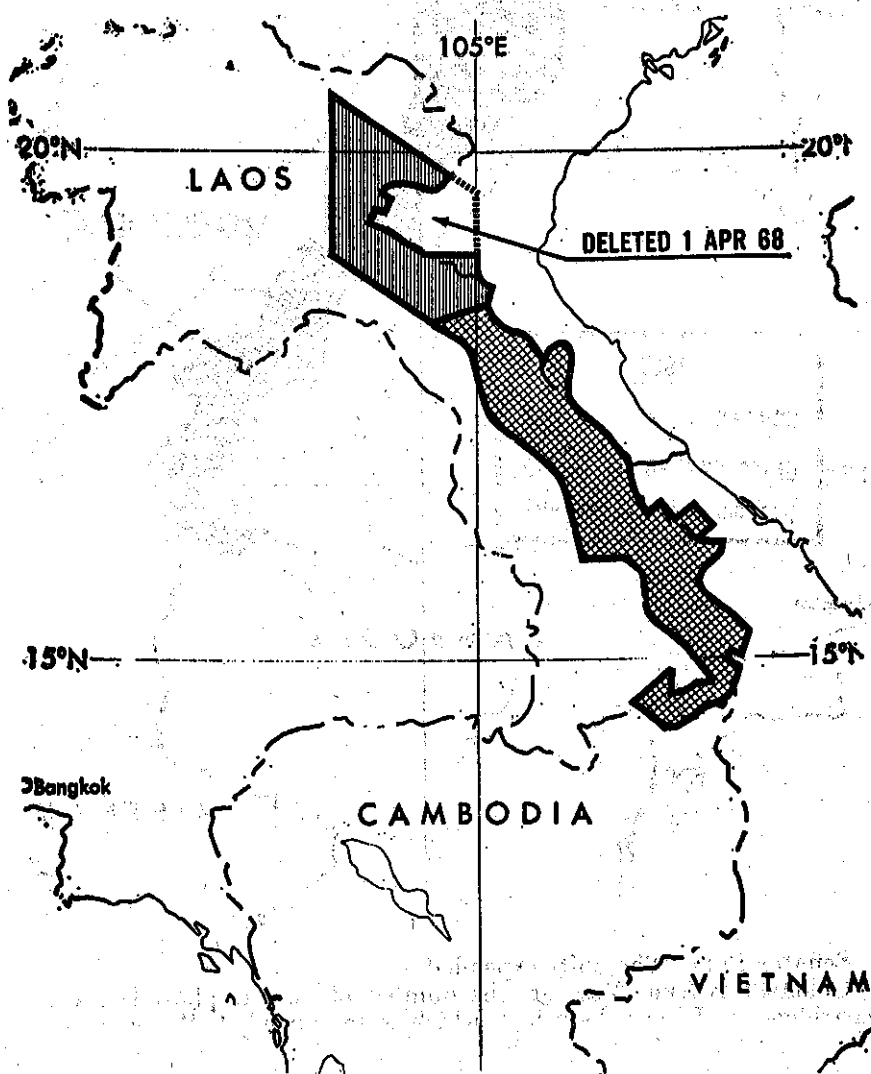
The next slide reflects the areas just briefed as they began in 1968.

On April 1, 1968, operations over North Vietnam were restricted to the area south of  $19^{\circ}\text{N}$  coincident with restrictions on bombing above that line.

[Chart 7 follows:]

CHART 7.—Restrictions of operations over North Vietnam on April 1, 1968.

[Supplied by Department of Defense]

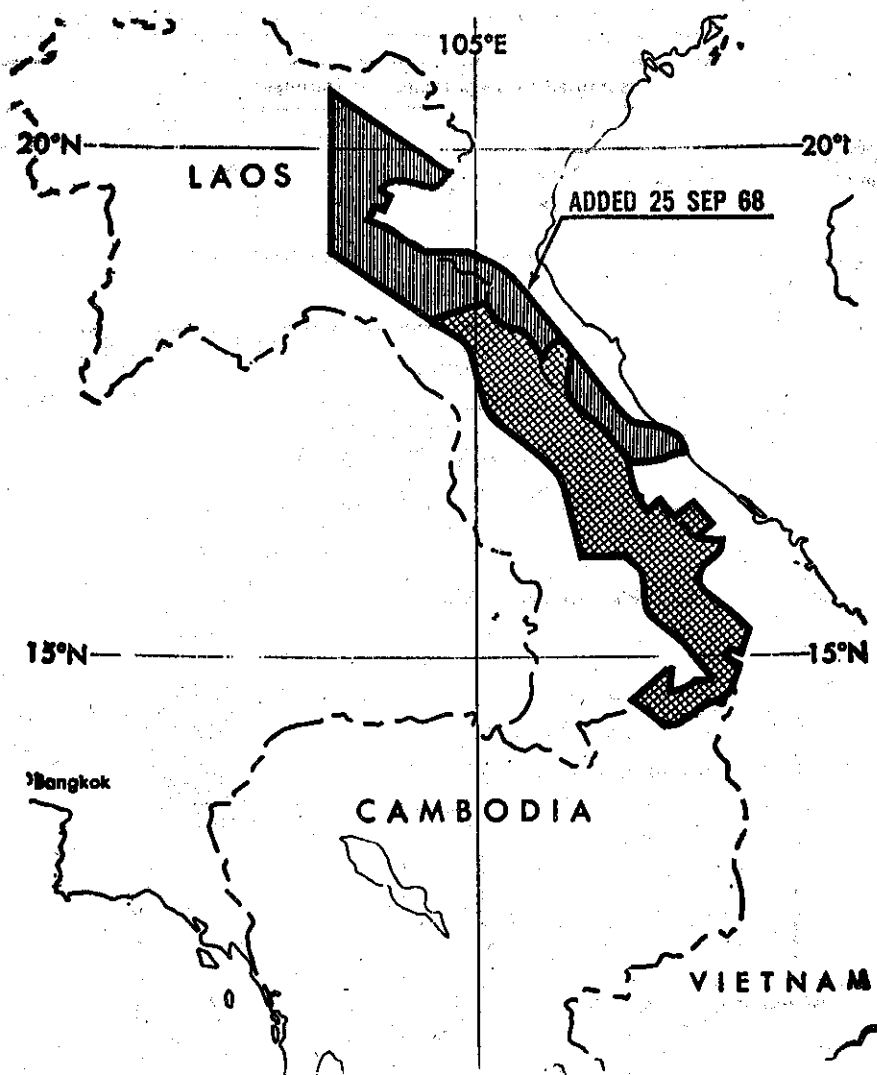


Colonel SOYSTER. An area of North Vietnam was added on September 25, 1968.

[Chart 8 follows:]

CHART 8.—Area of North Vietnam added on September 25, 1968.

[Supplied by Department of Defense]



Colonel SOYSTER. However, on November 1, 1968 all seeding operations within the boundaries of NVM were terminated and never reinstituted. This chart also shows the sorties and units expended for 1968.

Operations in 1969—

Senator PELL. Excuse me. When was it that you terminated?

Colonel SOYSTER. November 1, 1968, sir.

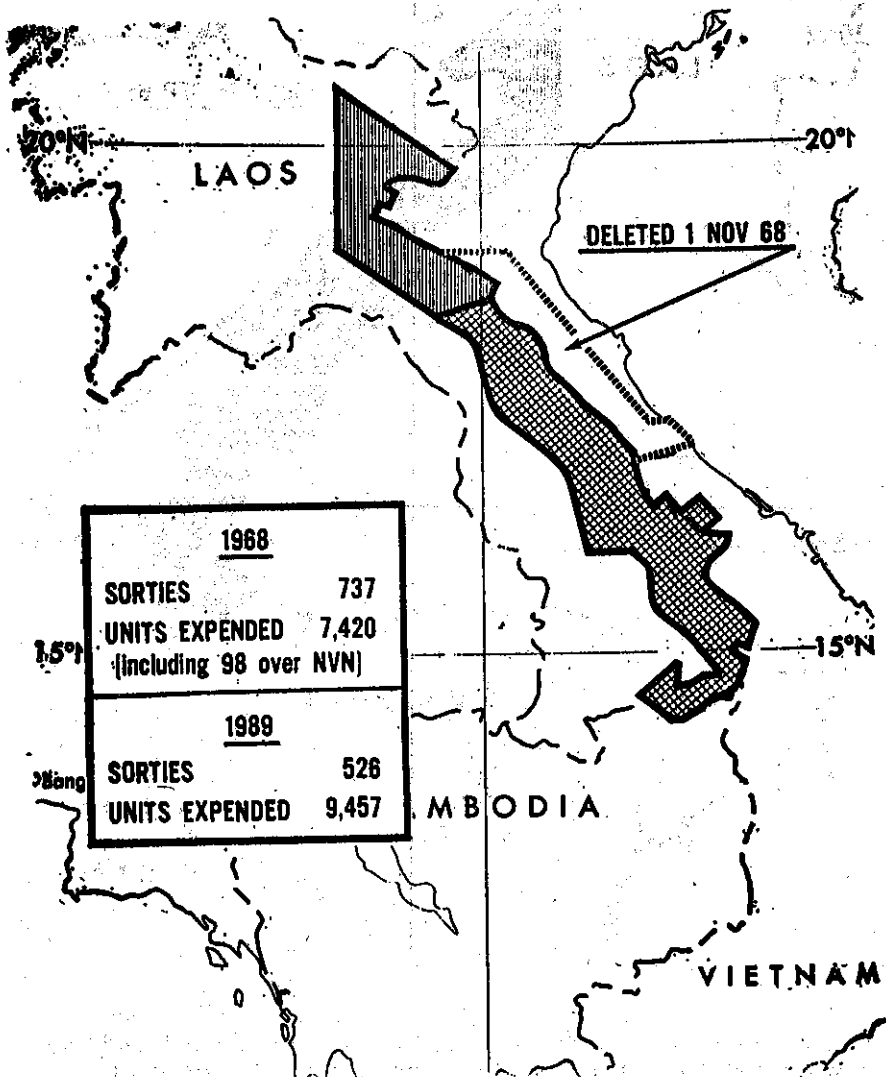
Senator PELL. Thank you.

Colonel SOYSTER. Operations in 1969 were conducted in the areas outside North Vietnam approved for 1968 and again the number of sorties and units expended are shown.

[Chart 9 follows:]

CHART 9.—November 1, 1968, termination within North Vietnamese boundaries and sorties and units expended for 1968 and 1969.

[Supplied by Department of Defense]



Colonel SOYSTER. During 1970, operational areas in Laos were modified as shown in the north and in the south. These are the units expended.

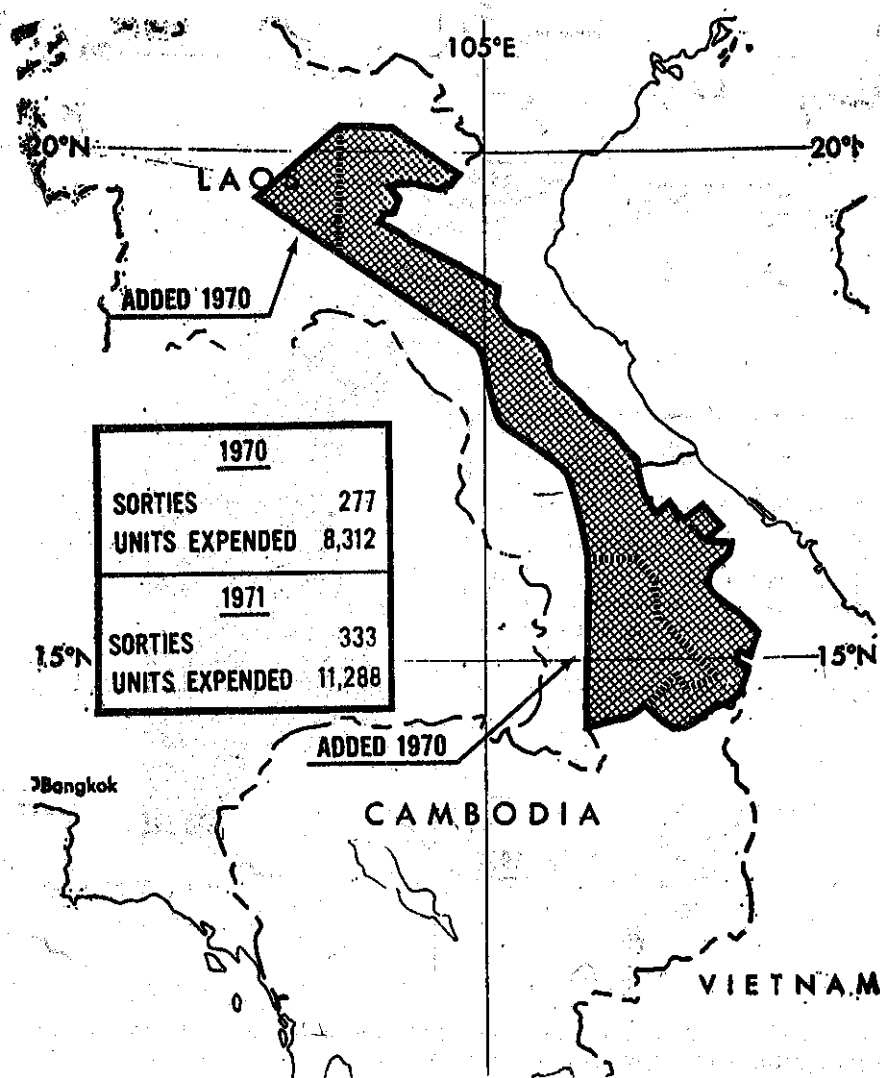


The 1971 area remained the same. These are the 1971 units and sorties expended in 1971.

[Chart 10 follows:]

CHART 10.—1970 modification of operational areas in Laos and sorties and units expended, 1970 and 1971.

[Supplied by Department of Defense]

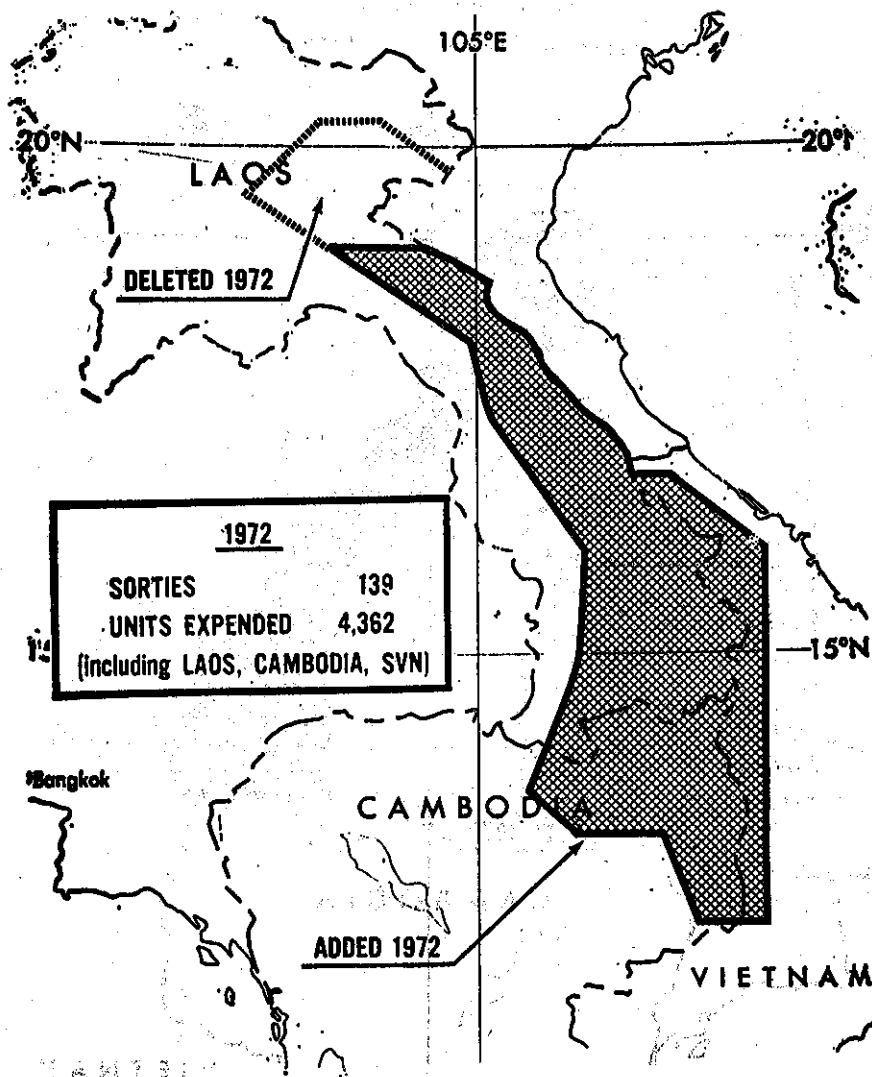


Colonel SOYSTER. The area was modified in 1972 to include portions of Northeast Cambodia and South Vietnam and to limit activity to south of 19° north in Laos.

[Chart 11 follows:]

CHART 11.—1972 modification of area.

[Supplied by Department of Defense]



Colonel SOYSTER. The next chart provides a wrap-up of sorties and seeding units expended for the program.

[Chart 12 follows:]

CHART 12.—Sorties and seeding units expended for program.

[Supplied by: Department of Defense]

YEAR	SORTIES FLOWN	UNITS EXPENDED
1967	591	6,570 (INCLUDING 1,017 OVER NVN)
1968	734	7,420 (INCLUDING 98 OVER NVN)
1969	528	9,457
1970	277	8,312
1971	333	11,288
1972	139	4,362 (LAOS, CAMBODIA, SVN)
<b>TOTALS</b>	<b>2602</b>	<b>47,409</b>

#### AVAILABILITY OF CHARTS

Senator PELL. Incidentally, just for the record, could these charts be made available for the top secret record?

Mr. DOOLIN. Certainly, sir.

#### SELECTION OF TARGETS

Colonel SOYSTER. The selection of targets or areas of seeding was based on the strategic importance of lines of communication and their susceptibility to interdiction by increased rainfall. Target priorities were assigned and updated on the basis of continuous analysis of all available intelligence information at 7th Air Force, Tan Son Nhut, South Vietnam. Priorities were stated in terms of drainage basins rather than points because of the low probability that a cloud favorable for seeding would form over a specific point. It was usually possible to seed every suitable cloud within a drainage basin, but priority was given to seeding clouds directly over roads, intersections, and river crossings within each basin.

## RESULTS OF PROJECT

The results of the project cannot be precisely quantified. This is due to the lack of sufficient ground stations to report. However, the Defense Intelligence Agency, using empirical and theoretical techniques based on units expended and the physical properties of the air mass seeded, estimated that rainfall was increased in limited areas up to 30 percent above that predicted for the existing conditions. Sensor recordings and other information following seeding indicated enemy difficulties from heavy rainfall.

Subjectively, it is believed that this rainfall was heavier than that which would have fallen normally and that it did contribute to slowing the flow of supplies into South Vietnam along the Ho Chi Minh trail.

## EFFECTIVENESS OF PROJECT

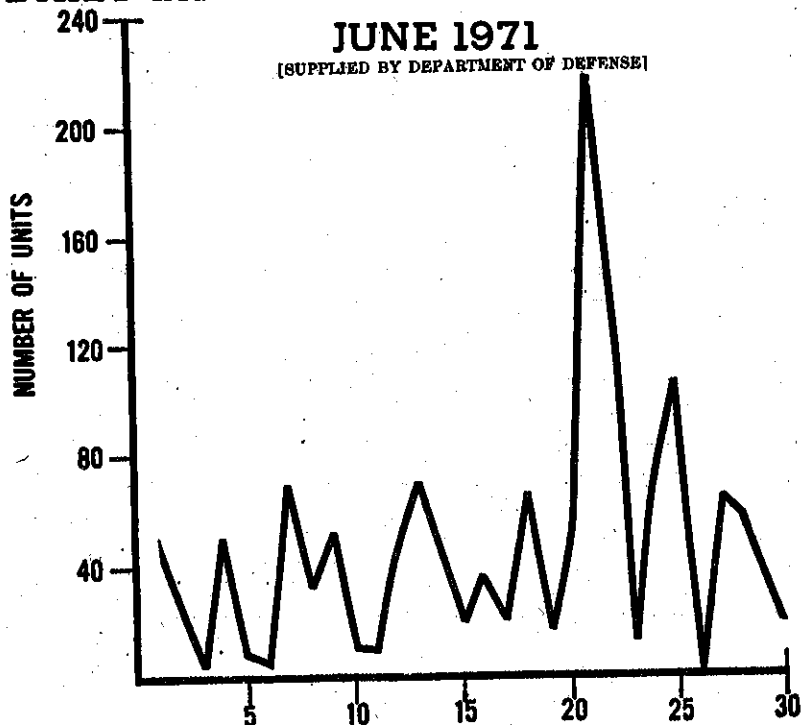
The next series of charts will be presented to provide some feel for the effectiveness of the project. The month of June 1971 will be addressed. June is a month in which the southwest monsoon is well established. It is also a month where it is not unusual for that southwest flow to be temporarily disrupted by the intrusion of a tropical storm moving into the Southeast Asian Peninsula from the east. This was the case for June 1971 when the southwest monsoon was disrupted by typhoon Anna as the month began and later in the month by typhoon Frieda and tropical storm Golda.

These storms, although bringing heavy natural rainfall, also caused poor seeding conditions by covering the area with a thick layer of high clouds which limit the effects of surface heating required for good convective activity. I provide this to point out that there was not a consistent presence of favorable conditions for seeding even in the middle of the rainy season. As a result, daily seeding unit expenditures vary greatly as shown on this chart.

I would like to point out while this chart is up that at the beginning of April remote sensors were detecting over 9,000 enemy logistic movers per week in eastern Laos. By the end of June this number was less than 900.

Two of the most significant weekly drops in detected traffic movement occurred during June. One of these weeks was June 2 to 9 during which a typhoon was increasing rainfall and the second was during June 16 to 23 when we were most active with seeding activities during the month.

[Chart 13 follows:]

**DAILY EXPENDITURE OF SEEDING UNITS**

This chart is an evaluation of the units expended by week. The left-hand column gives the total seeding units expended. The next column shows the number that were successful in the crews' judgment, which is to say that they had a positive effect on the cloud and either increased rainfall rate or caused cloud growth and development.

Under "Number of Groups" and "Number of Isolated Clouds" there is an evaluation where "S" means successful as I have just described, "NE" is no effect—and "F" indicates failure or a decrease in rainfall or cloud deterioration. The final columns show the number of lines of communications which were "influenced"—A route segment is said to have been influenced by project augmented rainfall if it is located directly under seeded clouds or within a reasonable distance so that runoff from the rainfall would cross it.

"Interdicted" are those instances where visual or photographic reconnaissance confirms significant water damage to a route segment previously listed as "influenced."

[Chart 14 follows:]

CHART 14.—Evaluation of units expended by week, June 1971.

[Supplied by Department of Defense]

DATES	# of UNITS		# of GROUPS			# of ISOD CLDS			# of LOC'S	
	TOTAL	SUCC	S	NE	F	S	NE	F	INF	IN'TD
1-8 JUNE	241	195	25	6	2	3	3	4	55	13
9-15 JUNE	240	223	23	0	1	24	10	0	80	5
16-22 JUNE	542	497	40	6	1	8	13	0	101	25
23-30 JUNE	368	360	27	3	0	16	0	0	93	3
1-30 JUNE	1391	1275	115	15	4	51	26	4	329	48

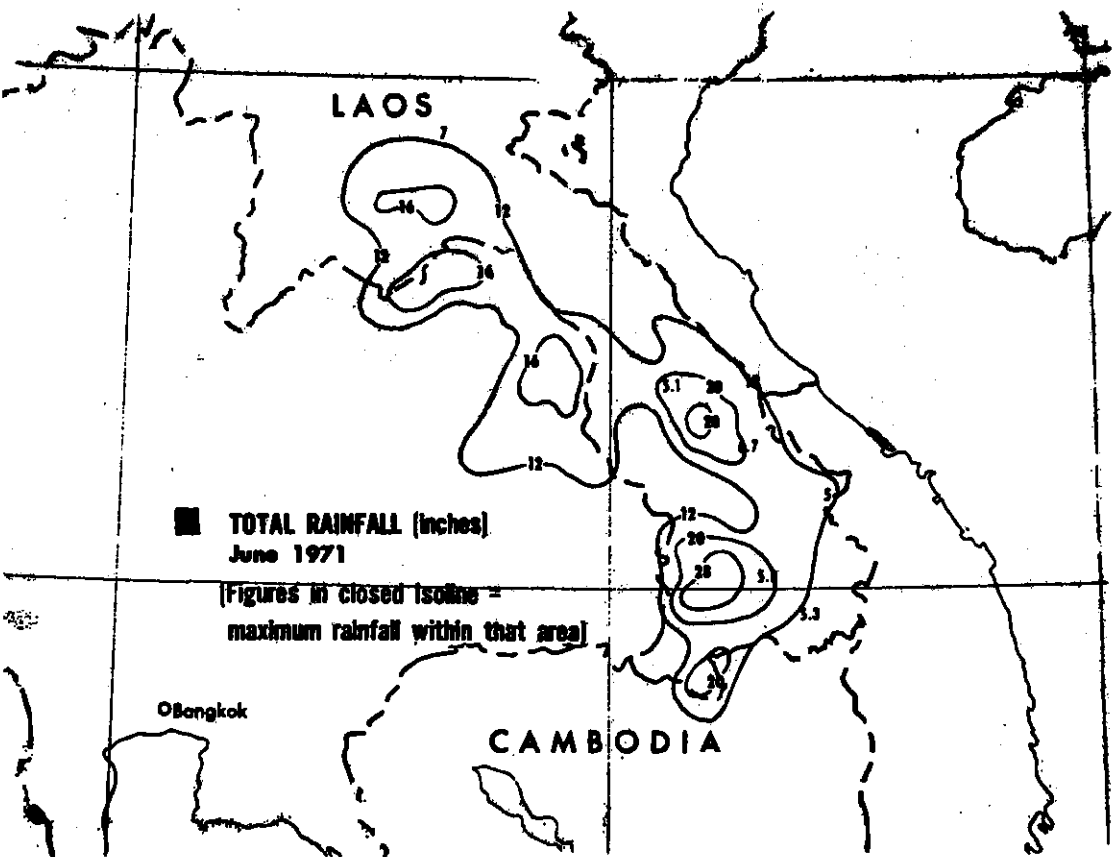
Colonel SOYSTER. The next slide measures effectiveness by the use of isolines. Chart 15 shows the total rainfall in inches which fell in the area for June 1971. This is a measured amount of rainfall from various points connected by isolines.

The lines in chart 16 are an estimate of the maximum rainfall that was induced in the area which the lines connect. The black numbers in the center of these lines on both charts show the maximum rainfall estimated for any one point.

[Charts 15 and 16 follow:]

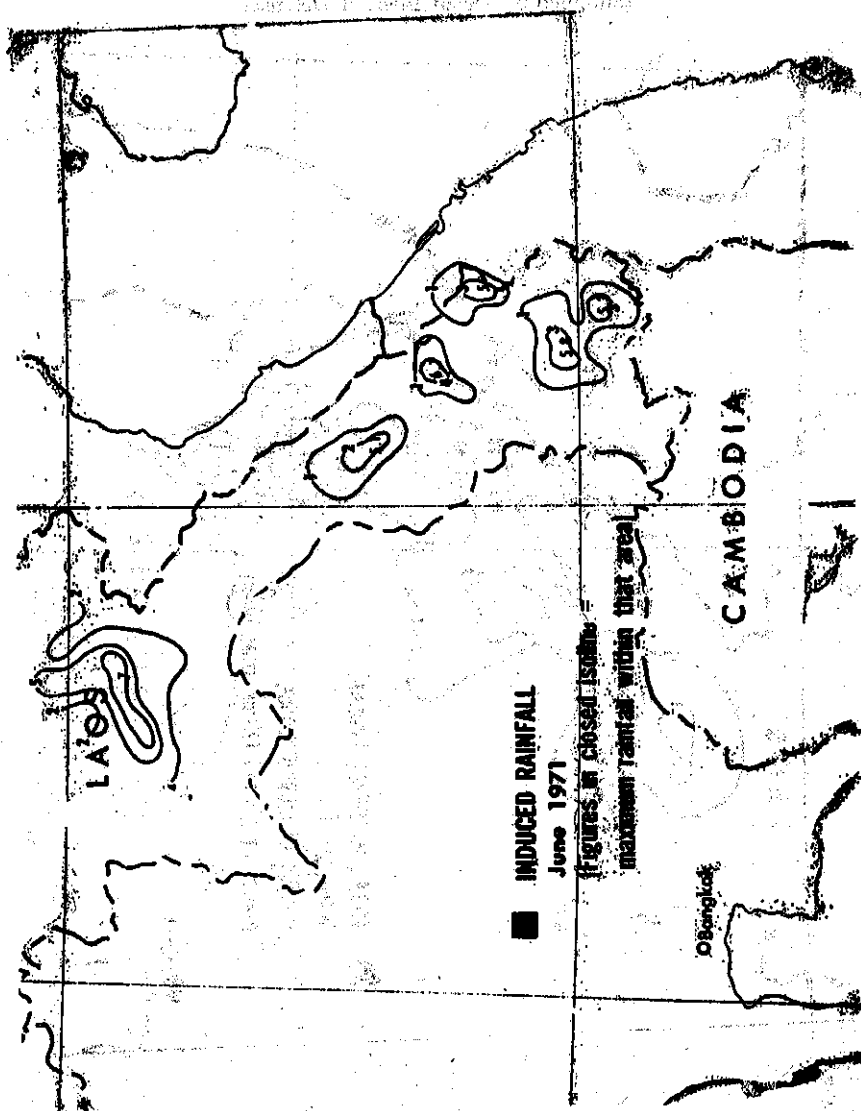
CHART 15.—Total Rainfall in Area, June 1971.

[Supplied by Department of Defense]



## CHART 16.—Induced Rainfall In Area, June 1971.

[Supplied by: Department of Defense]



## PROPOSAL, TEST AND OPERATIONAL PHASE

Colonel SOYSTER. As previously mentioned, the concept of the operation was proposed in 1966 by the Office of Defense Research and Engineering.

After approval by civilian authority, the test was conducted in October 1966 and the operational phase began March 20, 1967.



## REPORTING PROCEDURES

Because the program was considered sensitive, reporting procedures were instituted to limit knowledge of the program. The WC-130 missions were flown, recorded, and reported through normal channels as weather reconnaissance flights.

The crews performed weather reconnaissance and made normal factual weather reports through regular unclassified worldwide weather channels. The RF-4C's were flown as normal reconnaissance missions. In addition to these reports, special reports to provide information to higher headquarters and to allow evaluation of the project were transmitted through special communications channels. Daily reports were submitted to the command project officer. Weekly reports were submitted through channels to the Joint Chiefs of Staff. Semiannual reports were also submitted.

Periodic reports were prepared by the Joint Staff and submitted through the chairman, Joint Chiefs of Staff to the Secretary of Defense. In order to conduct the operation approximately 14,00 personnel had to be given access to project information over a 6-year period.

These people were briefed into the project and then debriefed when they no longer required a clearance.

## RESULTS OF PROGRAM

While this program had an effect on the primitive road conditions in these areas the results were certainly limited and unverifiable. It was conducted because of its apparent contribution to the interdiction mission and the relatively low program costs.

An operation such as this is almost unique to this area of the world. Rainfall can be significantly induced only where and when there are natural occurrences of heavy rains. Furthermore, induced rain can have a significant interdiction effect only where the lines of communication are relatively primitive.

Both of these conditions existed in the operating areas in Southeast Asia and, as noted, even here program effectiveness cannot be conclusively established.

This concludes the formal part of my presentation.

Senator PELL. Thank you very much, Colonel, for your good and full and frank briefing.

Is there anything further you wish to add?

Mr. DOOLIN. No; Mr. Chairman. We just wish to respond to any questions you may have, and I can leave a copy in advance of the transcript.

Senator PELL. Thank you so much.

## CLASSIFICATION OF PROGRAM

As you know, in connection with the Vietnam war, all the other combat sorties and ordnance tonnages have been declassified. Why are these statistics still top secret? Why is this program still considered top secret or is it still considered top secret?

Mr. DOOLIN. We are looking at this right now, Mr. Chairman.

Senator PELL. My own reaction is one of a little bit of puzzlement. What was the reasoning behind it being so highly classified.

Mr. DOOLIN. May I ask General Furlong?

Senator PELL. What was the logic behind it?

General FURLONG. It was, of course, at that time a combat operation. I would speculate that there was concern politically as well. We did not at the time when this began discuss normal combat interdiction operations in Laos. The Government of Laos was aware of our interdiction efforts and acquiesced in it. This operation fell into a similar category.

Senator PELL. But the classification was considerably higher. I know in my own experience here that this particular program was the only program about which the DOD did not feel able to respond to questions in either public or private session.

From what you say, I am reminded of the old maxim. An "elephant labored and a mouse came forth." What was the reason for this great secrecy?

General FURLONG. Your observation—the elephant laboring and bringing forth a mouse—I think reflects in large measure our current perception of the classification.

Senator PELL. I thank you.

Mr. DOOLIN. Certainly, Mr. Chairman, I must say that it reflects my perception of the results of the program.

Senator PELL. Yes.

Mr. DOOLIN. We are actively pursuing this in terms of declassification of the information.

#### DECLASSIFICATION OF SECRETARY LAIRD'S LETTER

Senator PELL. In connection with declassification, you should include Secretary Laird's letter. I don't believe this end of the avenue is responsible, but copies or knowledge of copies of it seems to be available to the press. And is there any reason why you should not go ahead right quickly with the declassification of his letter?

General FURLONG. We would do that in connection with the whole. That is, you would not declassify the letter and not go ahead and declassify more.

As Mr. Doolin points out, that is being considered.

[The information referred to follows.]

THE WHITE HOUSE,  
Washington, January 28, 1974.

HON. J. W. FULBRIGHT,  
Chairman, Senate Foreign Relations Committee,  
U.S. Senate, Washington, D.C.

DEAR MR. CHAIRMAN: I have just received new information dealing with a DOD weather modification program. Since I discussed this program with you in my April 18, 1972, appearance before your committee I want to share this information with you.

During my appearance I responded to your question concerning weather modification with the statement "we have never engaged in that type of activity over North Vietnam." That statement represented, first, my knowledge that I had never approved operations over North Vietnam and secondly, my understanding of activities authorized by preceding Secretaries of Defense. I have just been informed that such activities were conducted over North Vietnam in 1967 and again in 1968. I want to take this opportunity to both express my regret that this

information was not available to me at the time of my appearance before your Committee and to provide you with this information.

Please accept my personal appreciation for your friendship and assistance throughout my years in the Congress and the Executive Branch.

Sincerely,

MELVIN R. LAIRD,  
Counselor to the President  
for Domestic Affairs.

JANUARY 29, 1974.

HON. MELVIN R. LAIRD,  
Counselor to the President for Domestic Affairs,  
The White House, Washington, D.C.

DEAR MR. LAIRD: Thank you for your letter of January 28 clarifying your testimony of April 18, 1972 concerning the Defense Department's weather modification activities.

I brought your letter to the attention of the Foreign Relations Committee at its meeting this morning, and the Committee instructed me to ask you if, in view of the fact, that your 1972 testimony was in public, you have any objection to making your letter public.

Sincerely yours,

J. W. FULBRIGHT,  
Chairman.

FEBRUARY 11, 1974.

HON. J. W. FULBRIGHT,  
Chairman, Committee of Foreign Relations,  
U.S. Senate,  
Washington, D.C.

DEAR MR. CHAIRMAN: I appreciate your prompt response to my letter of January 28 concerning my testimony of April 18, 1972. Through my earlier letter I sought only to assure that you were provided with accurate information as rapidly as I received it.

It was thoughtful of you to afford me the opportunity to clarify the public record. However, to the best of my knowledge, the Department of Defense retains a security classification on this material which accounts for the classification of my letter to you.

I must, therefore, ask that my letter to you retain its classification as it would be inappropriate for me to act unilaterally without Department of Defense declassification approval.

With best wishes and kindest personal regards, I am

Sincerely,

MELVIN R. LAIRD.

FEBRUARY 14, 1974.

HON. JAMES R. SCHLESINGER,  
Secretary of Defense,  
Washington, D.C.

DEAR MR. SECRETARY: In the absence of Senator Fulbright during the recess of the Senate I am enclosing copies of correspondence between him and Mr. Laird respecting Defense Department weather modification programs.

I would appreciate it if the Foreign Relations Committee could have a determination from the Department of Defense with respect to making this correspondence public.

Sincerely,

PAT M. HOLT.

GENERAL COUNSEL OF THE DEPARTMENT OF DEFENSE,  
Washington, D.C., February 22, 1974.

Mr. PAT M. HOLT,  
Chief of Staff,  
Committee on Foreign Relations,  
U.S. Senate,  
Washington, D.C.

DEAR MR. HOLT: Secretary Schlesinger has asked that I respond to your letter of February 14, 1974 concerning correspondence between Mr. Laird and Senator Fulbright.

The Department of Defense has reviewed this matter and it is our determination that the SECRET security classification originally applied to this correspondence is still appropriate.

Sincerely,

L. NIEDERLEHNER,  
Acting General Counsel.

#### REASON FOR EXTRA SECRECY CONCERNING OPERATION

Senator PELL. There still may be no response, but I want to repeat my question. Do you have any idea or can you speculate as to the reason for the extra secrecy on this besides the interdiction factor, which I realize was classified.

Mr. DOOLIN. I speak in a personal capacity, and not in my official capacity, Mr. Chairman. I have been in this job for 5 years, and I didn't have this clearance even though Southeast Asia is in my area of responsibility in the Office of the Secretary of Defense. The first I learned of it was, as the result of a Jack Anderson column, and I made inquiries at the time—simply for my own edification—to find out if the rain that was artificially generated in a given area would deprive a friendly country also in the area of rain. For example, were we denying water to Thai rice paddies. I was told, no, that was not the case, that there was so much moisture in the air that you could not reduce the amount really in another area; and not to pursue the matter. It was an operation that was held in a special channel and access was very, very limited. I think, because of the perceived sensitivity of the operation.

Senator PELL. In retrospect, I think if this had been unclassified, there would have been far less feeling about it, but that I guess, is water over the dam.

#### CIVILIAN AUTHORITIES WHO APPROVED OPERATIONS

What civilian authorities approved these operations over the years 1966 to 1972?

Mr. DOOLIN. These operations were initially conceived by the Office of the Civilian Director of Defense Research and Engineering. They were then approved by the Secretary of Defense.

Senator PELL. What was that division again?

Mr. DOOLIN. The Director of Defense Research and Engineering, Dr. Foster, John Foster.

Senator PELL. Right.

Would that be Dr. Currie—

Mr. DOOLIN. It is now Dr. Currie.

Senator PELL. That is the same post.

Mr. DOOLIN. Yes.

Senator PELL. It would go directly from him to the Secretary of Defense.

Mr. DOOLIN. I don't know whether it went to the Joint Chiefs first but the Joint Chiefs obviously were in the chain.

Senator PELL. Right.

Mr. DOOLIN. But the approval authority in the Department was the Secretary of Defense.

From there it did go to the White House.

## WHO WAS INFORMED IN STATE DEPARTMENT?

Senator PELL. Who was informed in the State Department? Was anyone informed?

General FURLONG. There were a few informed in the State Department. I cannot give you their names.

Senator PELL. The functions.

General FURLONG. To the best of my knowledge the Under Secretary of State for Political Affairs was informed.

Senator PELL. Right.

General FURLONG. I cannot say whether that is the limit or not.

## WAS ANYONE IN ACDA INFORMED?

Senator PELL. Was anyone in the ACDA informed about it?

General FURLONG. No.

Senator PELL. They were not.

## WAS THIS ONLY CLASSIFIED WEATHER MODIFICATION OPERATION?

From what you said earlier, as I understand it, this is the only classified weather modification operation that has been carried out by the Government in the last 10 years. Would that be a correct statement, to the best of your knowledge?

General FURLONG. To the best of our knowledge.

Colonel SOYSTER. It is the only one, to my knowledge.

Senator PELL. To the best of your knowledge it was the only one.

Mr. DOOLIN. The only one.

Senator PELL. There were different code names, Operation Popeye and Operation Intermediary, Compatriot. Were they one and the same?

Mr. DOOLIN. They were one and the same.

Senator PELL. This was it.

Mr. DOOLIN. When the code names Compatriot and Intermediary were uncovered they were changed.

## ENVIRONMENTAL WARFARE

Senator PELL. Is there a coordinated executive branch position on environmental warfare, not just weather modification, but the other means of environmental warfare?

Mr. DOOLIN. That is my understanding, there is not.

Senator PELL. The thing that concerns me is not rainmaking per se, but when you open that Pandora's box what comes out with it? Will we achieve a technique to be able to both create and point a hurricane or typhoon? Will we be able to do geophysical modification, put a charge under the surface and let the earthquake follow?

General FURLONG. The testimony you have already received is I believe from personnel more competent than anybody from the DOD. I don't think we can contribute to your record.

Senator PELL. Thank you.

As you know, Dr. MacDonald has seen what it was, not the state of the art now but what it conceivably could be.

## DECLASSIFICATION OF PROJECT

I gather your personal views are that this project could be declassified without any great breach of national security?

Mr. DOOLIN. All I can say on that, sir, is that would be my recommendation to my superiors.

Senator PELL. Right.

## WEATHER MODIFICATION STUDY

Are you familiar with the study presently going on on the subject of weather modification, in which the Department is engaged as the lead agency?

Mr. DOOLIN. I am aware of a study that is being done for the White House.

Senator PELL. That is right.

Mr. DOOLIN. That includes some items such as that, yes.

Senator PELL. Yes.

When do you expect that study to be finished?

Mr. DOOLIN. I checked on that today, Mr. Chairman, and the estimate is it will be another 2 weeks or so before it is available for consideration in the DOD and then for transmittal to the White House.

Senator PELL. It will be another 2 weeks before pulled together by DOD.

Mr. DOOLIN. Yes, sir.

Senator PELL. What classification will that study have?

Mr. DOOLIN. I do not know, sir.

Senator PELL. You do not know.

Mr. DOOLIN. I am not involved in the preparation of that study.

Senator PELL. Right. The reason I am raising these questions is that this bears directly on my proposed weather modification treaty. When that study is in, we want to have another meeting with the Defense Department and the executive branch to discuss it.

Mr. DOOLIN. Mr. Chairman, this will be, of course, a report transmitted to the President at his request, so we would not have any control over its dissemination other than to the President.

Senator PELL. Senator Case, I have a series of other specific questions. Any time you wish to ask some, go ahead.

Senator CASE. Go ahead, Mr. Chairman, you are covering much of the ground I was interested in.

Senator PELL. I have already taken up my 10 minutes.

## CHANNEL OF APPROVAL OF OPERATIONS

Senator CASE. There were two questions suggested here, following the chairman's inquiry. Would you specify the precise channel for the approval of the operations?

General FURLONG. Yes, sir.

Senator PELL. Excuse me. Do you mean the other departments that are involved?

Senator CASE. Yes, and the Defense Department, too.

## THOSE WHO KNEW ABOUT PROGRAMS

And then a list of all of those who knew about the programs if you can.

Mr. DOOLIN. There were over 1,400 people at one time that did have this clearance including the men who flew the missions. I think it would be very difficult to compile.

Senator CASE. If not by name, give us a list by category, if you will, so we can see who had knowledge.

Mr. DOOLIN. We will do that, sir.

[The information referred to follows.]

## PERSONNEL INFORMED OF OPERATION AND ITS SCOPE

[Supplied by Department of Defense]

The following categories of personnel were informed in varying degrees as to the operation and its scope:

White House

Congress of the U.S.—Chairmen of DoD Jurisdictional Committees

Secretary of Defense

Deputy Secretary of Defense

Director of Defense Research and Engineering

Limited members of the staff of the Office of the Secretary of Defense.

The Joint Chiefs of Staff

Commander-in-Chief Pacific

Commander, US Military Assistance Command, Vietnam

Commander 7AF

Limited members of staff supporting these officers

Operational crews and supporting personnel

Secretary of State and limited supporting staff

Director CIA and limited supporting staff

DoD can verify that information was given to its personnel and the Chairman of its Jurisdictional Committees. Categories of non DoD personnel listed represent DoD's best estimate of those informed.

## APPROVAL BY OR DISCUSSION WITH CONGRESSIONAL COMMITTEES

Senator CASE. Was it ever approved by any congressional committee or discussed with any congressional committee?

General FURLONG. Preceding testimony has shown four committee chairmen were informed. We have nothing to add to the information already provided to the committee.

Senator CASE. Was that as a part of an oversight operation of some sort?

General FURLONG. No, sir. It was not done on a recurring basis.

Senator CASE. You just told four committee chairmen at a particular time.

General FURLONG. Yes, sir, that is correct.

Senator CASE. What were they? The Armed Services Committees

General FURLONG. Yes, sir, the Armed Services and Appropriations Committees.

Senator CASE. That only let Democrats in, didn't it?

[Laughter.]

Senator FELL. That is when it occurred in North Vietnam.

Senator CASE. Thank you, Mr. Chairman, go ahead.

## WHITE HOUSE KNOWLEDGE, APPROVAL, OR CLEARANCE

Senator PELL. As I say, I think you may have exaggerated the importance of the program. Who knew about it or gave the approval or cleared it in the White House? Could you submit for the record a list of the people?

Mr. DOOLIN. No, sir, I do not believe we can.

Senator PELL. Why?

Mr. DOOLIN. I know that information on this operation was sent to the White House. Whether it was for information or whether it was for approval, I do not know. I have been unable to find out.

Senator PELL. I realize you may have problems in trying it again. Could you try once more and submit for the record at the committee's request those who approved it at the White House and also for the record the list of other officials?

Mr. DOOLIN. We will try again, Mr. Chairman, because—we did try—because we wanted to be as fully responsive as we could be today, but unfortunately some of the principals who were involved at the time are dead.

[As of the date of publication, the information referred to had not been supplied.]

## DOD POSITION AT STOCKHOLM CONFERENCE

Senator PELL. Both Senator Case and I were at the Stockholm Conference on Environment. There was a tremendous flap there over the question of ecological warfare and weather modification. I remember the DOD representative, took a very strong position on the question of reporting weather and environmental activities to other governments. It was a mandatory provision in the first draft of the U.N. resolution. The DOD took a very strong position in that conference that it be changed to "whenever feasible."

What was the reason for the position of the Defense Department? I cannot understand why they are so concerned.

Mr. DOOLIN. I would not be competent to answer that. I really cannot go beyond what Mr. Forman has said on previous occasions.

Senator PELL. You read his testimony. He was very unforthcoming basically.

Mr. DOOLIN. I read the transcript of your last hearing, sir, partially to educate myself for this meeting.

## COORDINATION OF OPERATIONS

Senator PELL. Going to the question of the coordination of these operations, you say the State Department was informed but you did not necessarily coordinate with them.

General FURLONG. I don't think we ought to characterize the nature of that, sir. I am not confident which phrase is the correct description.

## WERE THAI AND LAO GOVERNMENTS INFORMED?

Senator PELL. Were the Governments of Thailand and Laos, both of which countries were involved, informed about these operations?



Mr. DOOLIN. The Royal Lao Government had given approval for interdiction efforts against the trail system and we considered this to be part of the interdiction effort.

The Royal Thai Government to my understanding was not informed.

#### OTHER WEATHER MODIFICATION PROGRAMS

Senator PELL. Since the secrecy of this program is held so tightly, do you think there could be other weather modification programs going on now in the Government of which you are not aware?

I am not asking this facetiously. I just don't know.

Mr. DOOLIN. It is possible, but I would think not. We have a Presidential decision of 2 years ago on weather modification. Only two foreign weather modification projects have been approved since then—one with regard to Panama to keep the canal clear of fog, and the other was a drought relief operation in the Azores.

Senator PELL. We used it also, I thought, on a friendly basis with other countries for clearing airfields and so forth.

Mr. DOOLIN. Those, sir, as I understand it, are the only two since the Presidential decision a few years ago. Before that, for example, we operated on Okinawa for drought relief. We assisted the Philippines at one time. Since the decision, as I understand it, there was a request from some of the Sahelian states in Africa. Our position has been that the technology is available through commercial contractors and therefore we have advised the countries to go to a commercial contractor for assistance in this regard.

Senator PELL. Have the armed services provided support or training or equipment in this regard to any foreign groups or any foreign governments or troops?

Colonel KAEHN. To some degree there has been interest shown by the Philippines in the techniques, the R. & D. we have done, and the methodology. The apparatus is commercially available.

Senator PELL. It is unclassified anyway, the research.

Colonel KAEHN. Exactly.

Senator PELL. And there is no law against it as of now in any case, either.

Colonel KAEHN. No, sir, not to the best of my knowledge.

Senator PELL. As far as you know, then we have not conducted any weather modification activity over Cuba?

Mr. DOOLIN. No, sir.

Senator PELL. The only ones we have done are in this part of the world?

Mr. DOOLIN. Yes, sir.

#### NSC INTERAGENCY PANEL

Senator PELL. In 1972 there was an NSC interagency panel under the chairmanship of Mr. Pollack to study the problems of weather modification, to formula American policy.

Did you have a representative on that panel?

Colonel KAEHN. Yes.

Senator PELL. Were you he?

Colonel KAEHN. No, I was not.

Senator PELL. Who was the representative?

Colonel KAEHN. The representative in 1972 was from the office of the Assistant Secretary of Defense for ISA [International Security Affairs]. That is the Under Secretary's committee's report which was produced 2 years ago, you are talking about?

Mr. DOOLIN. That would not have been my office, but the Deputy Assistant Secretary of Defense for Policy Plans, and NSC Affairs.

Senator PELL. It would not have been you, then?

Mr. DOOLIN. No, sir, but it would have been from the Office of Assistant Secretary of Defense for International Security Affairs.

#### NSC INTERAGENCY PANEL'S REPORT

Senator PELL. Are you at liberty to recall when the final report was made by this panel and what the classification is of that report?

Colonel KAEHN. If we are talking about the same one —

Senator PELL. I am talking about the one the Pollack Panel did. He was the chairman of it in 1972.

Colonel KAEHN. Yes.

Senator PELL. On this general field.

Colonel KAEHN. That report was submitted in the spring of 1972.

Senator PELL. That would be the one.

Do you recall the classification?

Colonel KAEHN. Yes. As I recall the classification was "Secret."

Senator PELL. "Secret." Would you be at liberty to tell us or can you recall the recommendations and findings of that report?

Colonel KAEHN. Without it in front of me, sir, I would rather not.

Senator PELL. I understand.

Perhaps you could look it up for the record. We are not asking for the whole report.

Mr. DOOLIN. I wonder if Mr. Chapin could be of any assistance?

Mr. CHAPIN. I do not know. I would like to look it up. I would prefer to verify the classification.

Senator PELL. All right.

Would you make note of our request that we receive the conclusions and recommendations of that report and give us something on that?

In fact, we would like to have for our file, unless there is some reason against it, and naturally observing its classification, a copy of them.

[As of the date of publication, the information referred to had not been supplied.]

#### DECLASSIFICATION OF SECRETARY LAIRD'S LETTER

Going for a second to Secretary Laird's letter, you are going to take that under advisement. My view would be that you would declassify the whole business.

Mr. DOOLIN. The specific matter of Mr. Laird's letter would depend on the decision that was made on the larger item.

#### PROPOSED DRAFT TREATY

Senator PELL. Are you at liberty to express a view with regard to our proposed draft treaty, what its effect would be on the Defense Department, your plans in being? Would it in any way inhibit you?

Mr. DOOLIN. Mr. Chairman, it is just not in my area of competence. I was here just in context of a briefing on the operations in Southeast Asia which is my area. I have my personal views on rainmaking, but I think you have had plenty of experts speak to you on that.

#### HEAVY FLOODING IN NORTH VIETNAM

Senator PELL. Was there any relationship between the rainmaking that went on in Southeast Asia and the extraordinarily high floods that occurred at that time in North Vietnam?

Mr. DOOLIN. There were not, sir. At the time of the heavy flooding in North Vietnam there were no rainmaking operations conducted. As Lieutenant Colonel Soyster said in his briefing, in the cases where adequate rainfall did occur then the seeding would have been superfluous and possibly counterproductive. Seeding could have destroyed the clouds. The flooding in North Vietnam, as you will recall, generated widespread civilian suffering and that was never the intention nor the result of this program. Rainmaking in this case would have not only been inappropriate, but also would have been prohibited by the standing orders.

#### NOVEMBER 1, 1968, PROHIBITION OF RAINMAKING OVER NORTH VIETNAM

Senator PELL. Why on November 1, 1968, was rainmaking over North Vietnam prohibited and never reinstituted? What was the reason for that date?

Mr. DOOLIN. I cannot speak for the administration.

General FURLONG. That was the day President Johnson announced the bombing halt. This fit in with the bombing halt. When you stopped operations in North Vietnam this operation was included as well.

Senator PELL. Right. Didn't we resume bombing of North Vietnam?

Mr. DOOLIN. Yes, sir.

Senator PELL. But these weather modifications were never resumed.

General FURLONG. No, sir.

#### EFFECTIVENESS OF PROGRAM

Senator PELL. What is your general view as to the effectiveness of this program? I gather from the testimony that you believe it did work and accomplished the purpose you wished.

Mr. DOOLIN. Again, I am not a scientist. I would go back to your elephant-mouse analogy. When you look at those isolines, and the amount of rainfall that was in these given areas anyway, and what was added to it possibly by these extra seedings, it looks to me like when you are getting 21 inches in a given area, and we add 2 inches, if I was on the bottom, I do not think I would know the difference between 21 and 23.

Senator PELL. Was that opinion shared in by the military?

Mr. DOOLIN. I cannot say.

Colonel SOYSTER. It was one of the most difficult parts of the project to try to quantify how well we were doing. The reports indicated we were able to induce rainfall and we knew that from other projects.

The quantification of it was the difficult portion.

## OTHER PROGRAMS BEING WORKED ON

Senator PELL. Are you familiar with any other programs we are working on now using rainmaking or, to clear fog from airports and for rescue operations? Do they come under your office?

Colonel SOYSTER. Not under mine, sir.

Colonel KAEHN may be able to speak to that.

Colonel KAEHN. Are you talking about clearing of fog in airports, sir?

Senator PELL. Yes.

Colonel KAEHN. I can speak to that from an R. & D. standpoint.

Senator PELL. And also from the standpoint of rescuing people.

Colonel KAEHN. There are two types of fog to deal with: one is called cold fog where the water exists at temperatures below freezing; it actually exists in water from below zero degrees centigrade; that is commonly called cold fog. We have demonstrated in the R. & D. sense the feasibility of eliminating this fog and we have attempted it at places like Elmendorf, Alaska, so you can get a C-141 in and out of there.

We have a more vexing problem, though, in the handling of warm fog. This is a more difficult problem considerably and one which we continue to do research and development work on.

The Navy is particularly interested in marine fog, the kind of fog that the Navy would encounter in its global mission at sea when it goes everywhere from the Polar to tropical meteorological regimes, and encounters different variations.

Senator PELL. Which is your office?

Colonel KAEHN. I am in the Office of the Director of Defense Research and Engineering.

Senator PELL. Are you aware of any other research that we are doing now with regard to other forms of weather modification for military reasons?

Colonel KAEHN. No, sir. To the best of my knowledge, the three main thrusts are the cold fog, warm fog, and the cumulus cloud work.

Senator PELL. You are not working on any of these far out thoughts that have been brought out in testimony before? You are not working on any of those projects at this time?

Colonel KAEHN. No, sir.

Senator PELL. The development of typhoons or the creation of earthquakes or the melting of the Greenland Icecap, anything of that sort?

Colonel KAEHN. No, sir.

Senator PELL. Obviously melting the Greenland Icecap would be very disadvantageous for us.

Mr. DOOLIN. That would really be what you would call climate modification rather than weather modification.

Senator PELL. Exactly.

Colonel KAEHN. The lead agency in the tropical storm modification program is the Department of Commerce: the program is called Stormfury.

In the past the Department of Defense has provided assets to Commerce to do the seeding work since we have the airframes to help them conduct the program. But the lead agency in that effort is the Department of Commerce.

# WEATHER MODIFICATION INFORMATION SOUGHT BY POLLACK COMMITTEE

Senator PELL. I would like to go back for a second to a previous question. The National Security Council Interagency Panel, the Pollack committee, was seeking information on military weather modification in Southeast Asia. Do you know if it was denied information by the Department of Defense in this area or can you recall that?

Colonel KAEHN. Sir, that was prior to my arrival in the Pentagon and I would rather research that.

Senator PELL. Could you, and submit it for the record.

In other words, I have three questions to ask you for the record in this regard: Did the Pollack committee seek information on weather modification in Southeast Asia? That is question No. 1. Was this information denied an agency of the Government. That is Question No. 2. If there was any denial of it, why was the committee denied this access? What was the reason for it? That is Question No. 3. These answers may all be very simple, but I do feel compelled to ask the questions.

[The information referred to follows:]

## POLLACK COMMITTEE'S SEEKING OF INFORMATION ON WEATHER MODIFICATION IN SOUTHEAST ASIA

[Supplied by Department of Defense]

Question 1. Did the Pollack Committee seek information on weather modification in Southeast Asia?

Answer. Yes.

Question 2. Was this information denied an agency of the Government?

Answer. Yes.

Question 3. If there was any denial of it, why was the committee denied this access; what was the reason for it.

Answer. Classification then assigned to this information precluded its availability.

## HAS DEPARTMENT OF DEFENSE WORKED WITH CENTRAL INTELLIGENCE AGENCY?

Have you worked at all with the Central Intelligence Agency in trying to carry out weather modification activities or was this completely a Department of Defense operation?

Mr. DOOLIN. Within the operations that were performed in Southeast Asia?

Senator PELL. That is right.

Mr. DOOLIN. This was the only time such an operation was carried out. It was done by the U.S. Air Force.

General FURLONG. This was all Department of Defense.

Senator PELL. Not the Central Intelligence Agency.

## IS THIS ONLY U.S. MILITARY WEATHER MODIFICATION ACTIVITY?

Is this the only weather modification activity that the U.S. Government has carried out for military reasons?

Mr. DOOLIN. We can only speak to what the Department of Defense did.

Senator PELL. I see.

Mr. DOOLIN. But, to the best of our knowledge, this is the only weather modification activity conducted by the Department of Defense that was classified.

We are aware of a series that were unclassified.

Senator PELL. Senator Case.

Senator CASE. No more, thanks, I think you have covered it.

#### DECLASSIFICATION RECOMMENDED

Senator PELL. I must say in conclusion that my own strong recommendation and thought is that you ought to declassify this, and we will ask you to declassify. We will keep your confidence, but you should give us your permission to declassify and publish today's hearing and the whole program because I think it would restore a great deal of confidence, not only in America, but around the world, in the intentions and capacities of the U.S. Government in this regard. There is nothing I can think of that we have said here today which, if published in the public press, would be of any harm. But we will leave that to you and your Department, keeping your confidence, although the Laird letter is slipping away out of our control because it seems to be known around town.

Mr. DOOLIN. Mr. Hersh has been trying to get ahold of me, from the New York Times, and I understand he would have been a better witness before you today than I am. [Laughter.]

Senator PELL. I thank you very much for your frankness and candor and your willingness to be with us. As I say, I hope you will very quickly look into this question of permitting this transcript to be released and the program to be released.

You have been hung for worse things than this, and if people knew what this was, all the people would—

Mr. DOOLIN. We will try our best.

#### POTENTIAL ADVISABILITY OF WEATHER MODIFICATION TREATY

Senator PELL. Are any of you willing to advance a personal view with regard to the potential advisability of our weather modification treaty, or do you not feel in a position to do so?

Mr. DOOLIN. Well, as I said, all I can really speak to is the rain-making aspect of it. If an adversary wanted to stop me from getting from point A to point B so I could do something at point B, I would rather he stopped me with a rainstorm than stopped me with a bunch of bombs. Frankly, I view this in that context as really quite humane, if it works.

In my own mind on the basis of the material that I have seen, I am not convinced that it had anything more than a marginal effect, but that is something that even the experts disagree on.

#### OPERATION ROME FLOW

Senator PELL. As you know, Operation Rome Flow stripped the green cover in Vietnam—

Mr. DOOLIN. To create the landing zones.

Senator PELL [continuing]. To create the landing zones and also make it more militarily controllable. That has resulted in a degree of climate modification. I am wondering if you had any view on that?

Mr. DOOLIN. The Rome Plow?

Senator PELL. Yes.

Mr. DOOLIN. I know in some areas it was necessary to use Rome Plow for reasons of urgent military necessity for clearing roads or an HLZ, helicopter landing zone, for example. The Rome Plow was not generally used in the context of expanding perimeter security. I may be wrong, but that was done primarily around fire bases, by the use of defoliants and active patrolling and not by Rome Plow.

Colonel SOYSTER. In my experience in Vietnam, which included a lot of perimeter defense, we did not have the equipment to do it. I never saw it in 10 months in Vietnam.

#### EFFECT OF VIETNAM WAR ON VIETNAM

Senator PELL. I think the effect of the war, as I understand it, not having been to Vietnam in the past few years, has been to radically change the character of the country and some of the climate of the country because the green cover has been eliminated. Obviously, these bomb hollows scattered over the country change the character of the country.

Mr. DOOLIN. I think you have to discriminate rather carefully there, Senator, as to what areas of Vietnam you are addressing. I have just returned from a—albeit much too brief—visit to Vietnam with Deputy Secretary Rush. I have made countless visits to Vietnam; I must say it is now the Vietnam I remember from the early 1950's. Saigon again looks like a Vietnamese city. The streets are being cleaned. The buildings are being painted. The bars are being shut down. There are no GI's running around.

The Delta exhibited an incredible prosperity. Aside from the money problems they have—inflation in the major cities which I think can be easily controlled if they get a handle on their commodity imports—the average farmer in the Delta is doing very, very well.

I think that the areas that you are talking about are primarily in the highlands.

Senator PELL. In the highlands, in the north.

Mr. DOOLIN. And in northwest MR-1, which are areas that basically are not considered part of Vietnam in the sense of the real vital living Vietnam even by the Vietnamese themselves.

General FURLONG. Mr. Chairman, one other thing that you might have your staff look at for you and that is the National Academy of Sciences report on herbicides. One of its findings addresses climatological modification resulting from defoliation. I believe it is their conclusion that that is not the case.

Mr. DOOLIN. In fact, I received a request, sir, if I recall, it was about 2 years ago by a team that went out there to study the effects of herbicides in Vietnam, and they went to an area that had been fairly extensively sprayed with herbicide, and they could find no lasting damage, and they requested permission from us to provide them with herbicides so they could respray it and take a look at it, and we told them no.

Senator PELL. I thank you.

## DECLASSIFICATION OF PROGRAM

I don't mean to divert from the subject at hand, but I thank you for the testimony. If I get queried by the press, I will relay to them what I have said to you, that I would urge you to declassify the whole program, that perhaps the secrecy has been exaggerated, and that I have not been able to ascertain a reason for this tremendous secrecy. I do not think anybody in this room understands the extrasensitivity for this program.

Senator CASE. It is the kind of thing that you maybe never will know, and maybe they won't, either.

[Discussion off the record.]

## DROPPING OF EMULSIFIERS ON LAO PANHANDLE

Senator PELL. One final and specific query here. Do you know anything about the dropping of emulsifiers on trails in the Loatian Panhandle?

Mr. DOOLIN. I do not.

General FURLONG. I heard there was to have been such a proposal. I have heard that it did not work very well and that we did not do any more of it. I do not think it was done by the DOD.

Senator PELL. What it basically does, I understand, is to make the trails slippery and impossible.

General FURLONG. Yes, sir.

Senator PELL. So it may have been attempted, but it was not under the Defense Department's jurisdiction.

General FURLONG. No, sir. First of all, it just would not work, and secondly, it would be dangerous for the crews, and third, we did not want to do it.

Senator PELL. Why would it be dangerous for the crews?

General FURLONG. Because if you were to do something effective, you are talking about lots of pounds of emulsifier. It is the kind of thing that takes a lot of poundage, and you have limited access to some fairly confined area in something like a C-130. As a former C-130 pilot, I would be less than enthused at flying low level over the Laotian Panhandle and shoveling out emulsifier. It just doesn't turn me on. I think sound military judgment prevailed and came to the same conclusion.

Senator PELL. Thank you. I thank you very much indeed and thank you for your frankness and for your being here.

The subcommittee will adjourn, subject to the call of the Chair.

[Whereupon, at 3:35 p.m., the subcommittee adjourned, subject to the call of the Chair.]