

OPERATION RANCHHAND

*The Air Force and
Herbicides in Southeast Asia
1961-1971*



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in Southeast Asia
1961-1971

• WILLIAM A. BUCKINGHAM, JR.

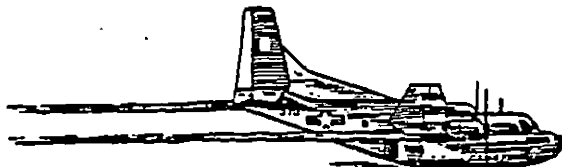
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Foreword

Since the dawn of powered flight, there has been debate about the uses of aviation in war. The air weapon could be, and has been, used for a variety of missions: to gain control of the skies, to bomb an enemy's population or war-making resources, to support armies and navies in battle, to interdict the flow of men and materiel to the battlefield, for observation, reconnaissance, the gathering of intelligence, to transport men and supplies, and for virtually every other aspect of modern combat.

One of aviation's more unusual military applications occurred in Southeast Asia, where American and Vietnamese planes sprayed large areas of Vietnam and Laos with herbicides in an effort to deny cover and concealment to the enemy, and to destroy his food supply.

Herbicides, or weed-killing chemicals, had long been used in American agriculture. After World War I, the military of various nations realized their potential for war and developed techniques to use them. Although the Italians had used lethal chemicals delivered from the air in Abyssinia in 1936, the Allies and Axis in World War II abstained from using the weapon either because of legal restrictions, or to avoid retaliation in kind. During the early 1950s, the British on a limited basis employed herbicides to destroy the crops of communist insurgents in Malaya.

In 1961, President Ngo Dinh Diem of South Vietnam asked the United States to conduct aerial herbicide spraying in his country. In August of that year, the South Vietnamese Air Force initiated herbicide operations with American help. But Diem's request launched a policy debate in the White House and the State and Defense Departments. On one side were those who viewed herbicides as an economical and efficient means of stripping the Viet Cong of their jungle cover and food. Others, however, doubted the effectiveness of such a tactic and worried that such operations would both alienate friendly Vietnamese and expose the United States to charges of barbarism for waging a form of chemical warfare. Both sides agreed upon the propaganda risks of the issue. At last, in November 1961, President Kennedy approved the use of herbicides, but only as a limited experiment requiring South Vietnamese participation and the mission-by-mission approval of the United States Embassy, the Military Assistance Command Vietnam, and South Vietnam's government.

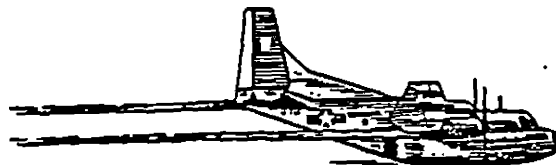
Operation Ranch Hand, the designation for the program, began in January 1962. Gradually limitations were relaxed and the spraying became more frequent, and covered larger areas. By the time it ended nine years later, some eighteen million gallons of chemicals had been sprayed on an estimated twenty percent of South Vietnam's jungles, including thirty-six percent of its mangrove forests. The Air Force also carried out herbicide

operations in Laos from December 1965 to September 1969 with the permission of the Laotian government.

One of a series of books detailing the Air Force's involvement in the war in Southeast Asia, this volume was written by Major William A. Buckingham, Jr., while assigned to the Office of Air Force History. The author rightly emphasizes that the Air Force served as an instrument of national policy in conducting the herbicide spraying. The book is a model study of the process by which military policy was made in the Southeast Asia War. Major Buckingham relates the intense controversy, both within the government and among the public, over the military, political, and ecological effects of the program. He connects policy to the operations, showing how pressure from scientists and disagreements among government policy-makers and military leaders imposed limitations on the spraying program. He explores the technical difficulties in using herbicides: the right chemical agents had to be delivered in sufficient quantity at the optimal time of the growing season, only against certain crops and categories of vegetation, and only in areas where the destruction provided harm to the enemy and no danger to friendly or neutral populations. And Major Buckingham pays tribute to the bravery of the Ranch Hand airmen who flew their planes "low and slow" over territory often heavily defended by the enemy. Remarkably, Ranch Hand's UC-123 Providers took more than seven thousand hits from ground fire, but lost only a few crews and aircraft. Indeed, the most celebrated of the planes, "Patches," survived over six-hundred hits.

The Ranch Hand operation was unique in the history of American arms, and may remain so. In April 1975, President Ford formally renounced the first use of herbicides by the United States in future wars. "As long as this policy stands," Major Buckingham writes, "no operation like Ranch Hand could happen again."

RICHARD H. KOHN
Chief, Office of Air Force History



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Lawrence J. Paszek, Mary F. Loughlin, and Vanessa D. Allen assisted in preparing this manuscript for publication by editing the drafts, selecting photographs, and planning the graphics, layout, and design of the book. Photographs were selected from collections held by the Defense Audiovisual Agency and the Audiovisual Archives Division of the National Archives. Especially helpful in providing not only photographs but also first-hand information was Maj. Alvin L. Young, an Air Force consultant in environmental sciences.

Members of the support staff in the Office of Air Force History—Ann W. Caudle, Barbara C. Fleming, and I. Jewell Newman—performed the burdensome task of typing and retyping drafts of the manuscript. Warren A. Trest and Dr. Richard Kohn, the Chief Air Force Historian, guided it through publication.

I am indebted to each of these people, and many more, and I credit much of the improvement in the book to their help. Of course, I accept responsibility for all errors which remain.

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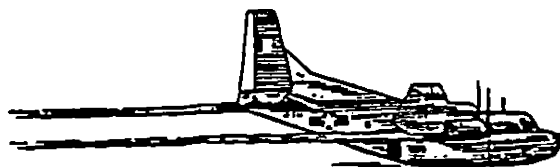
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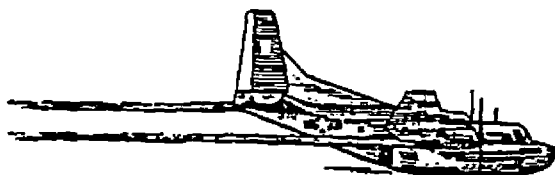
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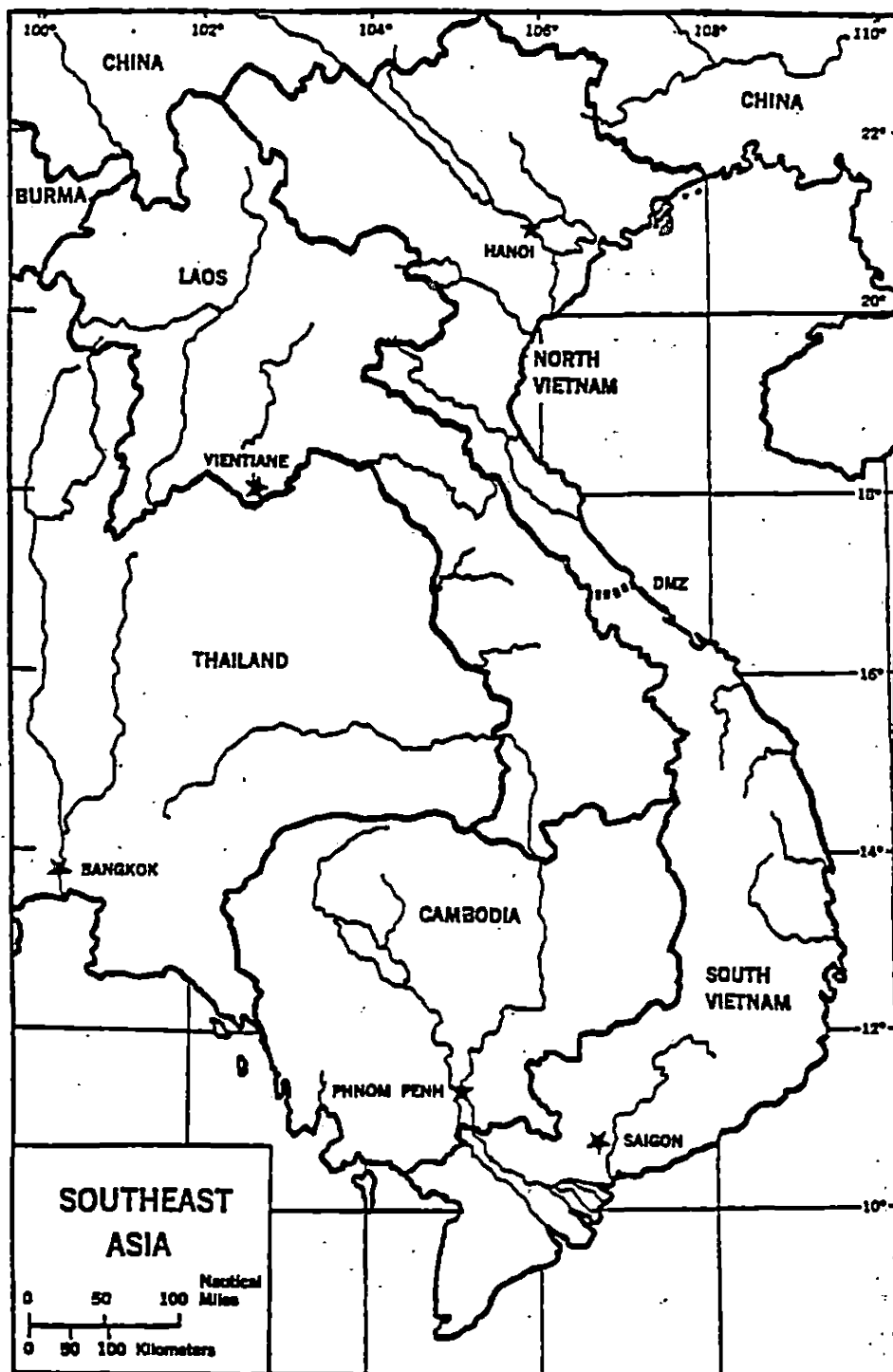
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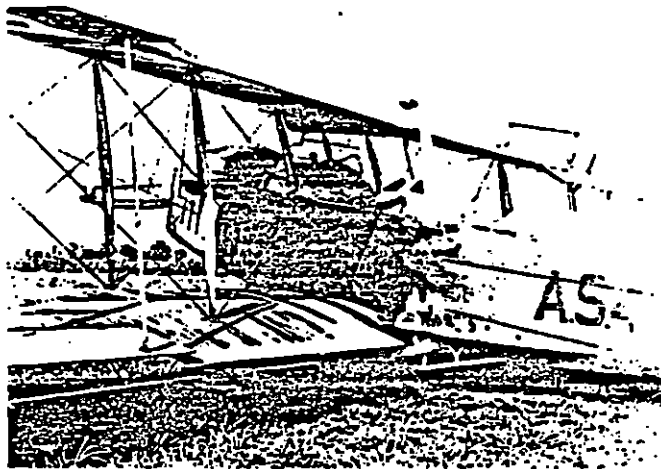
I. The Development of a Military Herbicide Capability

The problem of controlling insects in agriculture and forestry provided the initial spur for the development of the capability to deliver chemical sprays and powders from aircraft. Spraying poisonous liquids on leaf-eating insect pests using equipment located on the ground became accepted practice after World War I. Foresters used engine-driven pumps and, sometimes, thousands of feet of hose to control moth infestations in tall trees, but high labor costs and the inability of spraying rigs to reach the treetops made this method unsatisfactory. An entomologist from Cleveland, C. R. Neillie, believing that airplanes could be used to dust a stand of trees, worked with the Army Air Service at McCook Field in Dayton to test the idea.

The first experiments, on an infestation of sphinx caterpillars in a grove of catalpa trees near Troy, Ohio, were conducted on August 3, 1921. Lt. John A. Macready piloted a converted Curtiss JN-6 over the grove. J. S. Houser, an experienced forest entomologist, rode in the passenger's compartment. As Lieutenant Macready flew the plane about 25 feet above the treetops at a speed of 80 miles per hour, Houser turned a crank on a 32 gallon hopper attached to the right side of the fuselage and filled with poison dust. The wind blew the resulting dense cloud of lead arsenate over and into the trees. The two men flew across the grove six times, each pass taking about nine seconds. Within two days it was obvious that this experiment had been a resounding success. Thousands of dead caterpillars were hanging from the trees and lying on the ground. Observations six days after the dusting showed that 99 percent of the destructive caterpillars had been killed. Considering that the total time required to apply the dust from the air had been less than one minute, and comparing this with the time-consuming and laborious ground spraying method, the airplane had clearly proved its worth as a delivery vehicle for agricultural chemicals.

The success of this early aerial dusting experiment led to the use the following year of the airplane to control leaf worms on cotton plants in Louisiana. Air Service planes and pilots were also involved in these still experimental, but successful, spraying flights. The commercial potential of the new technology was obvious, and, by 1924, civilian aerial crop dusting concerns were in existence. In 1927, commercial dusters treated about 500,000 acres with insecticides. The early efforts using Air Service pilots and aircraft had proved the usefulness of the airplane for delivering chemicals, and exploitation of this new tool was soon underway.¹

Meanwhile, military interest in the airplane for spraying and dusting purposes concentrated on chemical warfare applications. A study completed in 1933² provides a good view of the thinking in the Air Corps during



Top photo: a crop duster over a Mississippi cotton field; center: the air suction hopper on this spray plane of the early twenties includes an outlet for discharging dust and a lever arm for opening and closing the feeder valve (the hopper lid is open); left: Lt. John A. Macready.

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this period. A primary assumption was that, in future wars, air forces would find chemicals to be attractive weapons, at least from a purely military standpoint. Compared with the other types of weapons carried by aircraft of the time, chemicals were highly destructive. Another forecast was that attack aviation, or what we today label tactical strike aircraft, would play the primary role in delivering chemicals by the spray method.

The report maintained that the chemicals used would be of three types: lethal and non-lethal agents, screening smoke, and incendiaries. One idea set forth, which was later revived and tested in Southeast Asia, was to use incendiaries to set fires in dry, wooded areas. The authors also proposed using chemicals to deny the opposition the use of rear areas and lines of communication. While planning in the 1930s involved the use of lethal agents, the Air Force used herbicides in Southeast Asia to remove jungle cover for these identical purposes.

By the 1930s the Air Corps had discovered the basic principles of aerial chemical delivery which would guide the use of herbicides in the 1960s. The techniques involved in carrying liquids in metal tanks aboard aircraft and discharging them through suitable nozzles were already well-established. Pilots had developed low-altitude delivery tactics, and they understood the effects of atmospheric convection, wind, and temperature on a spray mission. Drills, tests, and exercises continued through the remaining interwar years, and the Air Corps was well-prepared to conduct this type of operation when World War II began.

While military aerial spray activities in the United States went no further than drafting plans and conducting exercises during this period, in 1936 the Italian Air Force in Ethiopia used the airplane to deliver chemicals in combat. The use of gas during Italy's annexation of Abyssinia resulted in much political and moral condemnation of the Italians. However condemned, it was effective. One war correspondent maintained that S-81 bombers of the Italian Air Force dropping a type of mustard gas powder halted the only real Ethiopian threat of the war and saved the Italians from disaster.¹ Haile Selassie in his speech to the League of Nations maintained that:

Special sprayers were installed on board aircraft so they could vaporize over vast areas of territory a fine, death-dealing rain. Groups of nine, 15 or 18 aircraft followed one another so that the fog issuing from them formed a continuous sheet. . . . These fearful tactics succeeded. . . .²

Disagreements arose over the extent of the Italian effort and the identity of the chemicals used, but this episode nevertheless was a telling demonstration of aerial delivery of chemicals in combat.

During World War II, international legal restrictions and mutual restraint on the part of participants in the conflict kept American aviators from employing their skills in the delivery of lethal chemical sprays. Ironically, the spray equipment and flying techniques developed in the 1930s as part of the Air Corps' most destructive weapons were used in the 1940s in

the Pacific to save lives. Allied forces in the tropics experienced high rates of infection from mosquito-spread diseases. In fact, the casualties attributed to malaria and other insect-borne diseases exceeded those caused by enemy bullets. When the insecticide DDT was coupled with the proven spray capabilities of the airplane, a potent weapon was made available to use in fighting this menace.¹

World War II was also significant in providing background for the future events in Southeast Asia in that experiments were conducted in spraying defoliants from aircraft for military purposes. Such experiments in 1944 at Bayport and Marathon, Florida, at the direction of the Army Air Forces Board, tested the effectiveness of water solutions of zinc chloride and ammonium thiocyanate as defoliants of tropical vegetation. A-20 aircraft, carrying four standard 25-gallon M-10 tanks each, sprayed the test areas from altitudes of between 50 and 500 feet. Measurements were kept to determine the visibility of color changes produced in the vegetation by the spray, the increase in visibility within the forest as a result of defoliation, the change in the flammability of the foliage after treatment, and the amount of time needed for these effects to reach their maximum.

The conclusions drawn from these tests were generally unfavorable to the widespread use of defoliants. Chemically induced color changes proved impractical for marking bomb lines in fluid tactical situations, because the geographical distribution of forces could change significantly in the minimum period of 24 hours the tests showed were needed for visible color changes to develop. The use of chemicals in removing jungle cover to increase visibility was considered equally impractical because of the five to seven days needed for any appreciable defoliation to occur. The tests also showed that neither ammonium thiocyanate nor zinc chloride would increase the flammability of jungle vegetation. However, the researchers did conclude that aerial chemical spray could be used to mark rendezvous points or navigational aids on the crowns of dense jungle forests when appropriate advance notice was available. The most important tactical application discussed in the Board's report was the use of aerial spray to kill or damage food crops grown by isolated Japanese units on Pacific islands. Although these World War II tests did not lead to any large-scale operational program, it will be seen that the concerns expressed and the applications investigated in 1944 were closely paralleled in South Vietnam.²

Because the tactical situation and the vegetation in Korea were not conducive to the use of aerially sprayed herbicides (although mosquito spraying took place there), the next armed conflict in which herbicides found significant use was the British campaign against communist guerrillas in Malaya, formally known as the Malayan Emergency. The Emergency lasted from about 1948 to about 1960, but the role of herbicides was important only after 1952—primarily in 1953 and 1954. During this period, the British used helicopters and, occasionally, fixed-wing aircraft to spray food crops in isolated gardens tended by the insurgents. However, the aerial spray effort was

only one part of a strategy which could be effective in 1952, had been cultivated through affecting the

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There B-50, and 1952 laid the system. The developed:

Air Force built the MIC-1 system by a thick tank and

only one part of a much larger program designed to restrict supplies of food which could be used to support the communist insurgents. Because of the effectiveness of the British food control program, the insurgents, by late 1952, had been forced to withdraw from populated areas into deep jungle to cultivate their own food. Food production became the determining factor affecting their ability to survive.

In exploiting this situation, the British placed high priority on destroying the insurgents' cultivation plots hidden in the jungle. Ground troops sometimes destroyed the plots, but such use of troops proved to be uneconomic. As a result, S55, S51, and Whirlwind helicopters were used to spray the gardens with herbicides. The technique generally followed was to have Auster reconnaissance aircraft spot the plots and mark them, after which pairs of Hornets strafed the area to eliminate any ground resistance. The helicopters then descended over the plots and sprayed them with herbicides. At first, the British used sodium arsenite, but the danger it posed to the indigenous population was politically unacceptable. The most effective spray was a mixture of trioxene and diesolene which both killed the crops and rendered the soil sterile for a time.

As an indication of the level of intensity of these operations, in 1953, 88 cultivation plots were destroyed, the result of 63 hours of helicopter time devoted to spray missions. The crop destruction helped make the insurgents' jungle camps untenable, thereby forcing them to contact their supporters in the populated areas and increasing the chance that they would encounter British forces. However, the lack of sufficient helicopters and other aircraft to adequately pursue the crop destruction mission in addition to other tactical mission requirements, plus the difficulty in distinguishing insurgents' plots from those of the general population, resulted in crop spraying operations being held in abeyance after about 1954.⁷

In the United States, research and development in chemical herbicides was undertaken during the 1950s. A considerable amount of effort also went into improving the delivery equipment. In February, March, and April 1950, anticrop aerial spray trials were conducted at Avon Park Air Force Base, Florida, to determine whether C-47s could effectively spray undiluted chemicals from hollow cone nozzles. Later that same year, B-17 and B-26 aircraft conducted similar tests.⁸

There was also a need for a large capacity spray system that B-29, B-50, and C-119 aircraft could carry. An engineering study completed in 1952 laid the groundwork for the development of the MC-1 "Hourglass" system. The nickname referred to the speed with which the system was later developed and produced. By 1958, it had become a standardized item in the Air Force inventory.

Built by the Hayes Aircraft Corporation of Birmingham, Alabama, the MC-1 system included: a 1,000-gallon cylindrical aluminum tank insulated by a thick fiberglass blanket; a centrifugal pump; a control valve between the tank and the pump; a pipe assembly with fittings for six spray nozzles;

an opening for dumping the chemical contents in an emergency; an outlet for the connection of a recirculating and heating unit; and a dual set of controls and instruments.⁹ The B-29 and B-50 could carry an MC-1 in each of their two bomb bays, and a C-119 could carry one MC-1. The Air Force eventually bought 100 units, placing them in storage, along with chemicals, at Spokane. They later became the basis for the spray equipment installed aboard the Ranch Hand C-123s.¹⁰

In June 1959 an experiment at Camp Drum, New York, proved the value of aerially dispensed herbicides in improving visibility for military operations. Sugar maple foliage there hampered observation of shell bursts on an artillery firing range and needed to be removed. As was often true later in Vietnam, ground access to the area was impossible, but in this case because of unexploded artillery rounds rather than enemy activity. The Army Biological Warfare Laboratories sent Dr. James W. Brown, later involved in the earliest stage of the herbicide program in South Vietnam, to Camp Drum to assist in solving the problem.

Surplus drums of butyl esters of 2,4-D and 2,4,5-T* were obtained from the Air Force's original (1952) stock. Camp Drum personnel then devised an experimental spray system for use in an H-21 helicopter. Their system consisted of two 55-gallon stainless steel tanks; a gasoline engine driven pump; and a 23-foot spray boom with 24 nozzles. The H-21 sprayed a 1 : 1 mixture of 2,4-D and 2,4,5-T on the offending vegetation from 25 to 75 feet above the treetops at an airspeed of about 30 miles per hour. The deposition rate achieved was slightly more than one half-gallon per acre. The spray caused the desired effects, but not immediately. The dried leaves began to fall one month later.¹¹

While research went on elsewhere to develop anticrop chemicals and aerial delivery techniques, a unit at Langley Air Force Base, Virginia, was compiling an extensive record of operational spray missions—dispensing insecticides rather than herbicides. This unit, the Special Aerial Spray Flight (SASF) of the Tactical Air Command (TAC), later provided the aircraft and trained spray crews for the initial defoliation operations in South Vietnam.

The Special Aerial Spray Flight's origin can be traced to the successful antimosquito spray operations in the closing months of World War II. After the war ended, the IX Troop Carrier Command acquired the operational spray mission, and the Air Force became responsible for aerial spraying when it became a separate service in 1947. In January 1948, the Special DDT Flight, as it was then known, was transferred to Langley AFB. During the next twelve years, the Special Aerial Spray Flight, a name it acquired in 1951, experienced many changes in its organizational assignments, but Langley continued to be its home base. For much of this time, the Special

*See Appendix I, p. 195, for a discussion of these and other herbicides.

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DEVELOPMENT OF CAPABILITY

Aerial Spray Flight was not a unit in the normal sense—there was no permanent organization, just a collection of personnel authorizations which different people filled each year to undertake the seasonal spray missions. Under these circumstances, retention of experienced pilots with the necessary, highly specialized skills was a continual problem.

Operationally, in the fifteen years following World War II, the Special Aerial Spray Flight and its predecessors sprayed 69 different government installations while flying approximately 1,200 insecticide missions, largely in the eastern United States. In addition to the normal insect control activity, the spray planes flew special missions in times of disaster and for the purpose of testing new insecticides and equipment. The flight was called into service to combat plagues of grasshoppers in Kearney, Nebraska, and infestations of black flies in Maine. It also sprayed flies breeding on thousands of acres of dead fish killed by red tides along the Florida coast. The flight also participated in chemical and biological warfare research and flew several missions in 1951 in cooperation with the Biological Warfare Center at Camp Detrick, Maryland.

Three C-47 aircraft were assigned to the spray mission in 1946, and the Special Aerial Spray Flight used these same planes through 1960. The only additional aircraft assigned to the unit in fourteen years were three single-engine L-20 Beavers. The equipment allocated to the Special Aerial Spray Flight gives some indication of the relatively low priority the Air Force assigned to the spray mission during most of the pre-Vietnam period.¹²

Despite the low priority, by 1959 efforts were underway to acquire spray-equipped C-123s. The need for that aircraft became even more urgent in 1960 when the possibility arose that the Special Aerial Spray Flight might go out of business with the proposed elimination of C-47s and L-20s from the Air Force inventory. A severe shortage of spare parts for these aircraft already existed. In light of the situation, a preliminary planning conference was convened at Langley on August 16, 1960 to discuss acquiring and equipping of C-123s. Representatives from TAC, the Army, Navy, and U.S. Department of Agriculture attended. Capt. Carl W. Marshall, the Officer in Charge of the Special Aerial Spray Flight, who was later to command the first Ranch Hand detachment, chaired the conference. He proposed that the C-123 be modified to dispense both liquid and granular insecticides. The MC-1 spray system, teamed with the Navy's HIDAL (Helicopter Insecticide Dispersal Apparatus, Liquid) booms, could dispense liquid insecticides. A 10,000-pound-capacity hopper with a gravity feeding system and commercial spreaders could handle granular insecticides. However, with the knowledge that C-123s were in short supply, and that very complete justification would be required to reassign any to the aerial spray mission, the conferees concluded that only one C-123 should be obtained on a temporary basis to test both the liquid and the granular systems. If these tests proved successful, the group supported modification of three aircraft.

THE AIR FORCE AND HERBICIDES IN SOUTHEAST ASIA

This planning conference had concerned itself almost entirely with the C-123 as a dispenser of insecticides. Only one brief mention was made of another possible requirement which was later to be far more important. Captain Marshall at one point said that the aerial spray system installed on the C-123 should also be able to deliver biological and chemical warfare decontaminants and neutralizers, and vegetation control chemicals. These additional capabilities, however, should not reduce the system's capability to spray insecticides. Almost a year after the conference, the deteriorating situation in South Vietnam caused the modified C-123's secondary capability to deliver herbicides to become very important to officials at the highest levels of the American government.¹³

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II. The Decision to Send Spray-Equipped C-123s to South Vietnam

The question of what to do about Vietnam was waiting for President Kennedy's attention when he took office on January 20, 1961.¹ Worried cables had been flowing between Saigon and Washington for a year or so, but no sense of urgency had yet developed. For the previous eight months, a Counterinsurgency Plan for South Vietnam had been percolating through the Washington bureaucracy, and, after just one week in office, President Kennedy approved it. The plan offered to add some \$42 million to the current \$220 million U.S. aid program for Vietnam to enable enlargement of the South Vietnamese military forces. In return, South Vietnamese President Ngo Dinh Diem was asked to consolidate his military chain of command and to institute certain civic reforms. An underlying assumption of the plan was that if Diem would take the needed corrective civic measures and build adequate military forces, then the South Vietnamese government would have the potential to handle the threat posed by the Viet Cong.

The Counterinsurgency Plan soon ran into trouble as President Diem delayed the implementation of his side of the bargain in a pattern of inaction he was to repeat often during the remaining 33 months of his rule. The Joint Chiefs of Staff and the American military mission in Saigon were anxious to see the war against the Viet Cong accelerated, but Washington withheld its approval of increased American aid as long as Diem stalled. Despite these troubles with Diem, some elements of the American government and military leadership felt that the time to act against the Viet Cong in South Vietnam had come, that any further delay might threaten the eventual survival of a non-communist South Vietnam. Consequently, the Kennedy Administration developed plans and made many important decisions concerning Vietnam during its first year.

The series of events which led to the decision to send C-123s to South Vietnam to spray herbicides seems to have begun on April 12, 1961. On that date, Walt W. Rostow, a foreign affairs advisor to President Kennedy, forwarded a memo on Vietnam to the President.² He proposed a high-level meeting in the near future to consider "gearing up" the whole Vietnam operation as elections there had recently been held, and President Diem should therefore be free to undertake the reforms proposed earlier. Nine

THE AIR FORCE AND HERBICIDES IN SOUTHEAST ASIA

specific courses of action were mentioned in his memo. The fifth one recommended that a military hardware research and development team go to Vietnam to work with the chief of the U.S. Military Assistance Advisory Group (MAAG), Army Lt. Gen. Lionel C. McGarr, in exploring the usefulness there of various "techniques and gadgets" then available or under development. Aerial defoliation later became one of these unspecified "techniques and gadgets."

Later that same month, Roswell L. Gilpatric, Deputy Secretary of Defense, submitted a memorandum to President Kennedy which contained the proposals of an interdepartmental task force.³ These proposals comprised a multifaceted program designed to prevent a Viet Cong victory in South Vietnam. Among the military actions recommended was one to "... assist the G.V.N. [Government of (South) Vietnam] to establish a Combat Development and Test Center in South Vietnam to develop, with the help of modern technology, new techniques for use against Viet Cong forces." President Kennedy approved this recommendation and several other quite limited military proposals contained in the task force report at a National Security Council (NSC) meeting on April 29.

Shortly thereafter, the President decided to send Vice President Lyndon B. Johnson to reassure U.S. allies in Southeast Asia. The Vice President was also to personally deliver a letter to President Diem.⁴ The letter, signed by the President on May 8, discussed Administration concern about events in Vietnam and the possibilities of an expanded joint U.S.-South Vietnamese program of action built on the existing Counterinsurgency Plan. Specific military measures listed in the letter as being in addition to actions in the Counterinsurgency Plan included augmenting the American personnel assigned to the MAAG; providing material support to the Vietnamese Navy's Junk Force assigned to suppress clandestine supply and infiltration by sea; jointly developing methods to control infiltration across South Vietnam's land borders; and establishing a facility to develop and test new, modern, techniques to assist in the anti-communist campaign. The letter also dealt with joint political and economic efforts, and closed with an expression of confidence in the ability of the South Vietnamese to handle the situation.

Three days later, at the May 11 meeting of the National Security Council, President Kennedy made and reaffirmed several decisions of long range impact. The U.S. objective in South Vietnam was to:

... prevent Communist domination of South Vietnam; to create in that country a viable and increasingly democratic society, and to initiate, on an accelerated basis, a series of mutually supporting actions of a military, political, economic, psychological and covert character designed to achieve this objective.⁵

The President confirmed the specific military actions previously approved at the NSC meeting on April 29 and approved five additional actions he deemed necessary because of the increased security threat resulting from

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events in Laos which made that country's border with South Vietnam less secure. Defoliation eventually came to be associated with the first two of these actions:

- (1) Assist the G.V.N. armed forces to increase their border patrol and insurgency suppression capabilities by establishing an effective border intelligence and patrol system, by instituting regular aerial surveillance over the entire frontier area, and by applying modern technological area-denial techniques to control the roads and trails along Vietnam's borders. . . .
- (2) Assist the G.V.N. to establish a Combat Development and Test Center in South Vietnam to develop, with the help of modern technology, new techniques for use against the Viet Cong forces.⁴

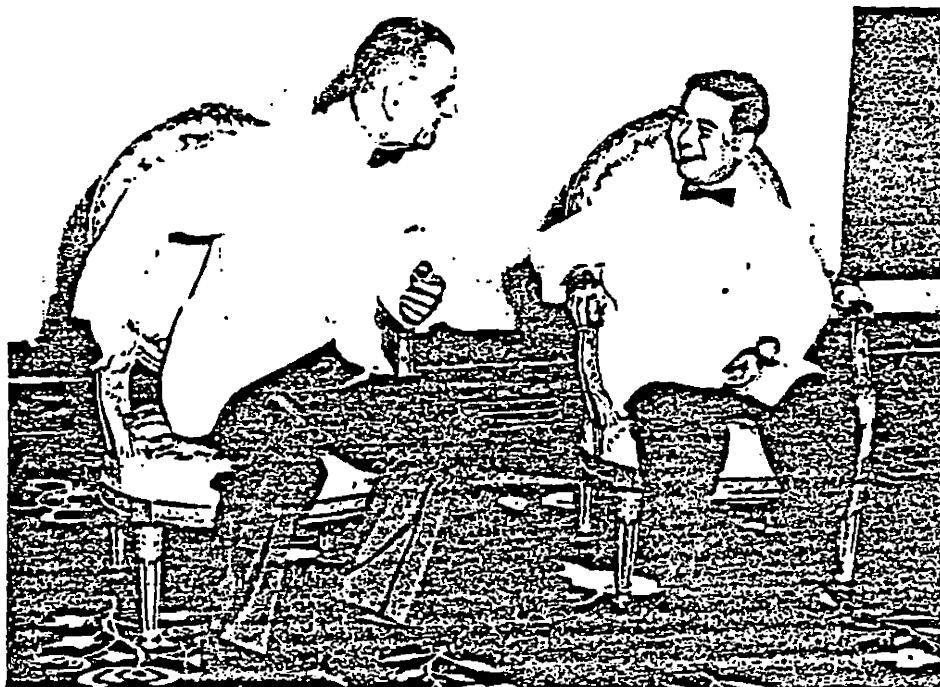
These two proposals, included in President Kennedy's May 8 letter, were accepted by President Diem—publicly in a joint communique with Vice President Johnson on May 13 and privately in a letter to Kennedy dated May 15.⁵

After the NSC meeting of May 11, the focus of action on border control and the exploitation of technology in counterinsurgency shifted from the White House to subordinate levels of the bureaucracy. On May 16, the Director of Defense Research and Engineering (DDR&E) was requested to initiate planning to send a team, at the earliest possible time, to assist the Vietnamese Armed Forces in employing new techniques and devices applicable to the guerrilla struggle in which they were engaged. The team was to be assigned to the Chief, MAAG Vietnam, on temporary duty and was to assist the Vietnamese in establishing a Combat Development and Test Center (CDTC). The mission of this group of experts was:

- . . . to acquire directly, develop and/or test novel and improved weapons and military hardware for employment in the Indo-Chinese environment, subject to political-psychological restrictions (such as those imposed by Communist claims of U.S. biological warfare in Korea).⁶

By July, thinking had progressed from general concepts of "techniques and gadgets" to specific proposals, including the use of defoliants. A report on developments as of July 10, 1961 stated that one research and development team had given attention to the problem of more effectively controlling South Vietnam's borders against unfriendly elements. This team considered using chemical plant killers for clearing "fire breaks" along the borders.⁷ Also during the week ending July 10, defoliation chemicals had been shipped to Saigon for tests by the newly established Combat Development and Test Center. A few days later, another report stated that ". . . all components needed for an extensive defoliation test are now enroute to Saigon."⁸

A South Vietnamese Air Force (VNAF) H-34 helicopter equipped with a HIDAL spray system flew the first defoliation test mission in South Vietnam along a road north of Kontum on August 10, 1961. Exactly two weeks later, a VNAF C-47 flew the first fixed-wing spray mission. Both missions dispersed the herbicide Dinoxol. President Diem personally selected the target for the C-47 mission on August 24. It consisted of a four-kilometer stretch of Route 13 about 80 km north of Saigon near the village of Chon Thanh. The Special Aerial Spray Flight provided the spray equipment used



Top: Vice President Lyndon B. Johnson with President Ngo Dinh Diem; bottom, l. to r. Ambassador Frederick Nolting, Jr., Gen. Paul D. Harkins, COMUSMACV, and Lt. Gen. Lionel C. McGarr, CHMAAGV, in Saigon.

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DECISION TO SEND SPRAY C-123s TO VIETNAM

in the VNAF C-47 and also sent TSgt Leon O. Roe to South Vietnam to assemble and install it. Capt. Mario D. Cadori, an experienced spray pilot formerly assigned to the SASF but at that time serving in the Pacific Air Forces (PACAF) area, was sent to train the South Vietnamese pilots who flew this and other C-47 test missions in low-altitude spray techniques. Although American evaluations of the results of this particular test were disappointing, President Diem was reportedly impressed by the overall results of the tests. He remained thereafter a staunch supporter of the defoliation program.¹¹

Within a few weeks of the first test, President Diem discussed the use of herbicides with a different type of target in mind. On September 29, 1961, at Independence Palace in Saigon, Diem and his advisors met with an American delegation which included Ambassador Frederick E. Nolting; General McGarr, chief of MAAG, Vietnam (CHMAAGV); and Adm. Harry D. Felt, Commander in Chief, Pacific (CINCPAC). Their discussion covered a wide range of issues, and towards the end it turned to the question of Viet Cong crops. President Diem expressed concern about there being large areas in the remote regions of his country where the Viet Cong had forced Montagnards to clear land and plant rice. Within about a month, he said, there would be a considerable amount of food for the enemy to harvest. He therefore proposed that immediate efforts should be made to destroy these crops before they could be harvested. Diem stated that he had heard of a "powder" which could be used to destroy the rice, but that President Kennedy would first have to authorize its use. After some discussion it was concluded that Diem's advisors had confused an available defoliant with other, more powerful, substances which probably fell into the closely-controlled area of chemical, biological, and radiological (CBR) weapons. Nevertheless, Diem stated that he did not care what was used as long as the Viet Cong could be denied access to the crops in these remote areas.¹² The meeting ended without any commitment from the American representatives about this matter.¹³

The situation in South Vietnam again came to the forefront in Washington in the fall of 1961. Although the official reports of "progress" in Vietnam at the beginning of this period were not pessimistic, there was an air of bleakness in the unofficial communications channels. Theodore H. White wrote the White House in August that the situation was getting worse week by week and that Diem's government suffered from a formidable political breakdown. He also reported that the Viet Cong controlled almost all of the southern Mekong Delta region and that he could find no American who would drive him outside Saigon, even by day, without a military escort. White's bleak assessment was confirmed when the number of guerrilla attacks tripled in September. That month also saw morale in Saigon shattered by the seizure of Phuoc Thanh, a provincial capital only 55 miles away. The Viet Cong controlled the town for several hours, publicly beheaded the province chief, and left before Diem's troops could arrive. This deteriorating, or, at best, stagnating situation led to another round of high-level decision-making on Vietnam.

THE AIR FORCE AND HERBICIDES IN SOUTHEAST ASIA

On October 10, a paper entitled "Concept of Intervention in Vietnam" was discussed at a meeting attended by both the Secretaries of State and Defense.¹⁴ The main thrust of the paper, drafted mainly by Deputy Under-Secretary of State Alexis Johnson, presented a concept for introducing United States forces into South Vietnam, preferably under a Southeast Asia Treaty Organization or United Nations umbrella, possibly in conjunction with a similar military intervention in Laos. The military objective of such a move would be to secure South Vietnam's borders against the infiltration of men and supplies from North Vietnam, a mission a force of 22,800 men could handle. However, a supplemental note to the paper issued the next day postulated that "cleaning up" the Viet Cong threat would require about 40,000 U.S. troops, and as many as 128,000 might be needed if North Vietnam and China overtly intervened. Defoliation operations were one of several proposed supplemental actions which could be carried out right away while a decision was pending on the major issue of committing large numbers of combat troops. The original Johnson paper proposed that U.S. aircraft be used to conduct a "major defoliant spray program in South Vietnam," although the aircraft would carry South Vietnamese markings and the pilots would wear civilian clothes. A supplemental note, dated October 11, phrased the defoliation proposal somewhat differently:

Carry out defoliant spray operations, using hired commercial planes and pilots (CIA). These operations would initially be experimental, designed to prove out and further develop the capability to use defoliant sprays to clear off jungle access routes.¹⁵

An October 11 National Security Council meeting with President Kennedy also dealt with the Johnson paper. According to the recollection of one of those in attendance, the only immediate action approved by President Kennedy was the sending of the Air Force's "Jungle Jim" counterinsurgency squadron to South Vietnam to carry out a training mission under the MAAG. The President deferred a decision on the major question of sending large numbers of American troops to South Vietnam as well as on the other alternatives, including defoliation. Instead, President Kennedy decided to send a delegation headed by Gen. Maxwell Taylor to Saigon to investigate the political and military alternative actions. He also directed the State Department to undertake related diplomatic efforts.¹⁶

Meanwhile, the proposal to conduct a major defoliation operation was being more fully developed. As early as September 23, a joint State-Defense message had stated that emergency actions were needed to support the Diem government and suggested that defoliants for an operational program be included in a list of items to be delivered without delay.¹⁷ The Combat Development and Test Center developed a massive operational program at about the same time on the basis of favorable results from tests on manioc and on jungle foliage. The plan had four goals:

- a. Stripping the Cambodian-Laotian-North Vietnam border of foliage to remove protective cover from Viet Cong reinforcements;

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- b. Defoliating a portion of the Mekong Delta area known as "Zone D" in which the Viet Cong have numerous bases;
- c. Destroying numerous abandoned manioc groves which the Viet Cong use as food sources;
- d. Destroying mangrove swamps within which the Viet Cong take refuge.

And it was to be conducted in two phases:

• PHASE I: Defoliate within 30 days twenty percent of Zone D and adjacent Cambodian border, manioc groves and mangrove swamps.

PHASE II: In ninety days after completion of Phase I, defoliate remaining eighty percent of area D, the entire border, remaining manioc groves and mangrove swamps in Viet Cong dominated areas.

Counting both phases, this proposal envisioned the defoliation of 31,250 square miles of jungle, an area equivalent to about half of South Vietnam! In addition, the proposal called for spraying 1,125 square miles of mangrove swamps and 312.5 square miles of manioc.

The projected cost of the CDTC proposal—\$75 to \$80 million—and the fact that it would have consumed chemicals at a rate which would have exceeded the existing manufacturing capacity in the U.S. pointed up its excessive scope." The proposal suggested that the spraying could be done by six C-47 aircraft with crews, maintenance personnel, and spray rigs provided by the U.S. Air Force, plus four Army helicopters and a number of ground-based spray units. The plan also called for the defoliated areas to be burned where they were sufficiently dry, an action which would facilitate their later use as farmland. The proposal cautioned, however, that the defoliation program would only be of value in helping to defeat the Viet Cong if it were accompanied by a vastly increased Army of the Republic of Vietnam (ARVN) offensive effort to exploit the results. The planners also recognized that such a program could expose the United States to charges of conducting chemical or biological warfare."

Another suggested defoliation program of lesser scope devised by American officials in Saigon replaced the massive CDTC program a few days later." This more limited plan consisted of three sequential programs. Phase I, to begin within twenty days, would spray 334.5 square miles of manioc and rice crops with 2,4,5-T and cacodylic acid. The second phase would begin within 65 days, last about thirty days and defoliate 200 square miles of jungle in Zone D with 2,4-D and 2,4,5-T. This second phase would be coordinated with military actions. During Phase III, certain unspecified border areas would be selectively defoliated. The overall cost of the revised program was estimated at \$4 million to \$6.5 million, less than a tenth of the

"Brown maintains that the excessive size and cost of this proposal may have been due to an error in arithmetic or in message transmission. See Rprt. Dr. J.W. Brown, U.S. Army Chemical Corps Biological Laboratories, subj: "Vegetational Spray Tests in South Vietnam, Supplement," April 1962, p 68.

cost of the original proposal. The proposal for the reduced program also indicated shortcomings in the use of C-47 aircraft for disseminating defoliants, and stated that aircraft in the United States (presumably, C-123s) could be equipped with the MC-1 spray system within a few weeks if sufficient priority were assigned to the task.²⁰

In a memorandum dated November 3, 1961, the Joint Chiefs of Staff recommended to the Secretary of Defense, Robert S. McNamara, that Admiral Felt be authorized to implement the limited, three-phased defoliation plan. The JCS memorandum also stated that these operations should be carried out "... in conjunction with fully coordinated attacks on Viet Cong forces." The Chiefs advised caution, however, on crop destruction:

3. The Joint Chiefs of Staff are of the opinion that in conducting aerial defoliant operations against abandoned manioc (tapioca) groves or other food growing areas, care must be taken to assure that the United States does not become the target for charges of employing chemical or biological warfare. International repercussions against the United States could be most serious. In this connection, it is recommended that the operations be covered concurrently with a publicity campaign as outlined by Task Force Vietnam in Saigon.²¹

This last recommendation may have reflected doubt on the part of Gen. Lyman L. Lemnitzer, the Chairman of the Joint Chiefs of Staff, over the value of a crop destruction operation in Vietnam. The previous month, he had written Gen. Maxwell Taylor, military advisor to President Kennedy, and cautioned him against drawing too many parallels between the British experience in Malaya and the situation facing the Diem government in South Vietnam. He pointed out that food had been scarce in Malaya, and this had made the British food denial program an important and readily usable weapon. General Lemnitzer contrasted this with the relative plenty in South Vietnam, thereby questioning the wisdom of conducting a food denial campaign there.²²

Secretary McNamara responded to the recommendations of the Joint Chiefs on November 7. He, too, was concerned about the possibility of an adverse propaganda impact, but he did not limit his concern to the food denial phase. He stated that the American Embassy in Saigon had been asked to comment on the possibility of persuading President Diem to assume responsibility for the proposed program and to issue an explicit public statement which would include the assertion, believed at that time, that the spray would not be harmful to livestock or humans. Pending the solution to this problem of defending the defoliation program against adverse propaganda, Secretary McNamara said that he could not decide whether or not to carry it out. He did, however, recognize the restraints imposed by time on any attempt to attack the fast-maturing Viet Cong crops. Accordingly, to preserve his options, Secretary McNamara directed the Air Force "... to provide, on a priority basis, the required aircraft, personnel, and chemicals." He assigned operational control of the project to CINCPAC.²³

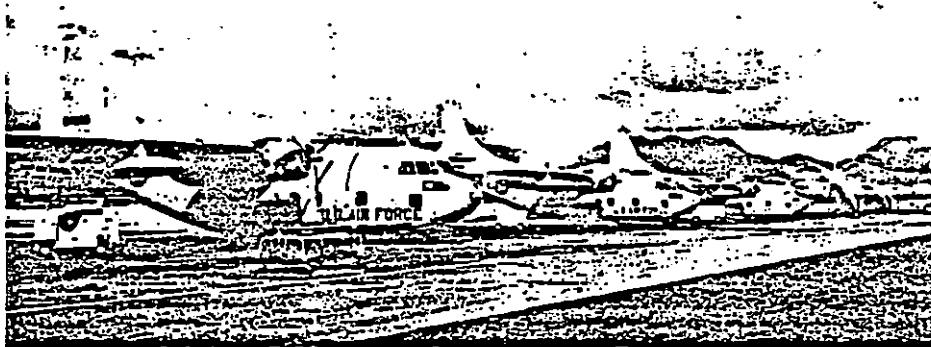
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One week later, William P. Bundy, Acting Assistant Secretary of Defense for International Security Affairs, forwarded a memorandum to Secretary McNamara on the defoliation question which summarized recent developments and further examined the rationale for the program. In describing the food denial aspect of the proposal, Bundy stated that the actual spraying for this phase would be carried out by Vietnamese helicopters and personnel, although the use of U.S. Marine helicopters from Okinawa or Japan was still under consideration. Air Force C-123s would undertake the other two phases involving the removal of jungle cover. The Tactical Air Command had been notified on November 9 to modify six C-123s for spraying purposes and had been directed to send the planes to Southeast Asia to join the Jungle Jim unit already in South Vietnam. Bundy also reported that the Air Force had procured, from the Army, the chemicals required for the first phase of the operation and that they were being flown to Vietnam. Ships would transport the chemicals for subsequent phases. In addition, spray rigs for use on VNAF H-34 helicopters had been requested from CINCPAC resources; they would be available within one week. Bundy confirmed that Admiral Felt had assumed operational control of defoliant operations in accordance with McNamara's directive and had, in turn, delegated planning and coordinating responsibility to the Chief, MAAG Vietnam.

Bundy also outlined the various favorable and unfavorable aspects of the proposed defoliation program in more detail. On the plus side, he noted that U.S. diplomatic and military representatives in South Vietnam had recommended approval without reservation. In addition, preliminary tests were favorable, and approval would comply with President Diem's wishes. The negative aspects included the distinct probability that the North Vietnamese would exploit propaganda aspects of a defoliation program by making charges of chemical or biological warfare. Bundy also pointed out that for the plan to produce any military benefits, the South Vietnamese would have to provide ground troops and a coordinated plan to use them. In conclusion, Bundy stated that from the military standpoint, the program should be approved. However, in light of the political and psychological warfare risks involved, he recommended that President Kennedy be asked to give the final clearance.¹⁴

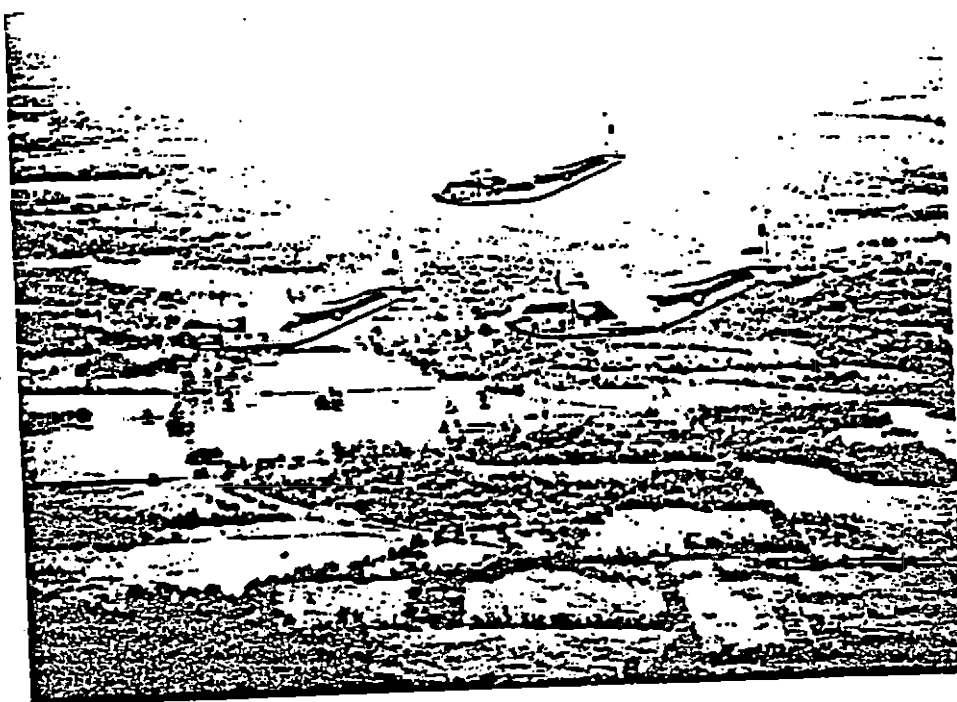
As William Bundy had suggested, the defoliation proposal was sent to President Kennedy for a final determination. In making his decision, the President had before him the written recommendations of both the Departments of State and Defense. The Deputy Secretary of Defense, Roswell L. Gilpatric, presented the Defense Department's position. He repeated most of the arguments which Bundy set forth but developed them more fully. He emphasized to the President that the proposed defoliation program would incorporate discriminative target selection and mission execution. He was, however, more concerned than Bundy with the political warfare aspects of the problem. He reported to the President that Radio Hanoi had announced

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Top: C-123s at Hickam AFB, await deployment to Vietnam for defoliation activities; bottom: crewmembers board a C-123 Ranch Hand aircraft.

DECISION TO SEND SPRAY C-123s TO VIETNAM



Top: Sec. Robert S. McNamara, Gen. Lyman L. Lemnitzer (3d from right), Gen. Paul D. Harkins, visit Americans in Vietnam, May 9, 1962; bottom: Fairchild C-123s.

THE AIR FORCE AND HERBICIDES IN SOUTHEAST ASIA

on November 6 that the South Vietnamese had used "poison gas" on the rice crop near Tay Ninh, making people ill. Gilpatric conceded that killing crops in the remote areas of South Vietnam inhabited by Montagnards made sense militarily, but he was concerned about the possible effects on Montagnard attitudes and worried that "... the use of chemicals to destroy food supplies is perhaps the worst application in the eyes of the world." Another shortcoming was that Diem had no known plans to resettle the Montagnards. However, Gilpatric calculated that a crop destruction program could have a net favorable effect and the public relations difficulties could be mitigated if the problem of resettling and feeding the Montagnards could be solved.

Gilpatric likewise had substantial reservations about using defoliants in a major effort to clear Zone D near Saigon and to control South Vietnam's borders. His concern in both cases stemmed from a lack of confidence in the ARVN's capability to exploit the defoliation missions with ground action, without which defoliation alone would be of little or no value. In regard to the mounting of an organized ground attack in Zone D, he said "... it seems clear that it would be a stern test of Vietnamese capabilities and probably beyond what they could attempt in the present state of morale and organization." Similarly, concerning border control he stated, "Mere clearing will not accomplish a great deal, unless we are ready with helicopters and/or border patrol forces to patrol the areas and do a job." Both of these proposals for the use of defoliants, in Gilpatric's view, should be delayed pending the development of realistic plans along with the demonstration of a willingness and ability on the part of the South Vietnamese to properly exploit these aspects of the defoliation program.

The one proposed use of defoliants about which Gilpatric expressed an unreservedly positive view to the President was the clearing of key routes. He noted that such clearing would forestall ambushes and allow freer movement on transportation arteries and that this use of defoliants would not be substantially different from what was already being done in clearing rights of way in the United States. Gilpatric's view was that using defoliants on a modest basis to clear vegetation away from roads, railroads, and canals would be a desirable first use and a low-risk method for testing world reaction.

A significant and unresolved issue which Secretary Gilpatric described for the President concerned the markings to be carried on the defoliation aircraft and the nationality of the crews which would fly them. He noted again that the food denial operations could be carried out by South Vietnamese aircraft and crews but that the other missions would have to be flown by someone else. A possibility he mentioned was placing South Vietnamese markings on the aircraft (presumably Air Force C-123s) and having them flown by "covert" aircrews. Because of the nature of the aircraft, however, he did not feel that such measures would effectively disguise the U.S. role in the operation. He therefore recommended against the covert approach.

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DECISION TO SEND SPRAY C-123s TO VIETNAM

In his summary, Secretary Gilpatric presented to President Kennedy the Department of Defense view that there were two possible alternative decisions:

- a. To avoid the use of this material wholly on grounds of net adverse local reaction, and particularly of worldwide disapproval. On this, we have no clear judgment, since it depends on factors that can best be assessed by the Department of State.
- b. To go ahead with a selective and carefully controlled program starting with the clearance of key routes, proceeding thereafter to food denial only if the most careful basis of resettlement and alternative food supply has been created, and holding Zone D and the border areas until we have realistic possibilities of immediate military exploitation.

The Department of Defense preferred the second option. Gilpatric also emphasized his department's view that the use of defoliants should be closely controlled by Washington with "careful prior consideration and authorization" of the operational plans developed by CINCPAC and U.S. representatives in Saigon.²⁵

Secretary of State Dean Rusk expressed the State Department's views on defoliation, and they were generally in agreement with Gilpatric's memorandum. Secretary Rusk told the President, "The use of defoliant does not violate any rule of international law concerning the conduct of chemical warfare and is an accepted tactic of war." He cited the British crop-spraying operations in Malaya as a precedent. However, he warned that the United States would probably become the target of an intense "germ warfare" campaign initiated by communist nations, and, perhaps, echoed by some neutral countries. Nevertheless, Rusk expressed the view that:

... successful plant-killing operations in Viet-Nam, carefully coordinated with and incidental to larger operations, can be of substantial assistance in the control and defeat of the Viet Cong.

Accordingly, Secretary Rusk seconded Gilpatric's recommendation for a limited initial defoliation program restricted to transportation routes, with close control and supervision retained in Washington.²⁶

President Kennedy accepted the joint recommendation of the Departments of State and Defense on November 30, 1961. His decision was straightforward and followed very closely the views of Gilpatric and Rusk:

The President has approved the recommendation of the Secretary of State and the Deputy Secretary of Defense to participate in a selective and carefully controlled joint program of defoliant operations in Viet Nam starting with the clearance of key routes and proceeding thereafter to food denial only if the most careful basis of resettlement and alternative food supply has been created. Operations in Zone D and the border areas shall not be undertaken until there are realistic possibilities of immediate military exploitation.

The President further agreed that there should be careful prior consideration and authorization by Washington of any plans developed by CINCPAC and the country team under this authority before such plans are executed.²⁷

THE AIR FORCE AND HERBICIDES IN SOUTHEAST ASIA

President Kennedy had committed the United States to a course of action which led to the extensive Ranch Hand defoliation and crop destruction operation in Southeast Asia.

At the time of his decision, Vietnam was by no means the most critical foreign and military policy problem facing President Kennedy's still-new administration. During the summer of 1961 the Soviet Union had precipitated a serious confrontation over continued Western presence in Berlin and affirmed an intention to unilaterally abrogate all Western rights there. The United States' response to this challenge included increasing draft calls, extending the tours of duty of servicemen, and calling up reserves. As a result, U.S. conventional forces were stretched thin. The Soviets had also unilaterally resumed atmospheric nuclear tests at the same time negotiations were underway to reach an agreement banning such tests. And, during April, when many important decisions involving Vietnam were being made, the Bay of Pigs invasion of Cuba was failing.

The situation in Laos was equally troubling. The pro-Western faction there, supported by the United States, suffered serious setbacks at the hands of Laotian forces supported by the Soviet Union. The United States almost sent troops into Laos in 1961, and many of the important decisions of that year regarding South Vietnam were made in light of, and, to some extent, in response to the more serious situation in Laos.

Even limiting the focus to South Vietnam, defoliation was a relatively minor issue in 1961. Much weightier options were under consideration. Just a few days before President Kennedy decided to use herbicides, he had faced a crucial decision on the issue of sending American troops to South Vietnam.²² By contrast, defoliation was a lower priority issue.

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III. The Deployment of Spray Aircraft to South Vietnam and Initial Defoliation Operations

As mentioned earlier, with Secretary McNamara's decision to send herbicides and spray planes to South Vietnam, the Tactical Air Command had been given the mission of providing six C-123s and support sufficient for four months of field operations.¹ Inquiries relative to the spray capabilities of the C-123 had begun in July, and it was no surprise to the Special Aerial Spray Flight when the formal tasking came. The SASF at Langley already had two C-123s at Middletown, Pennsylvania, undergoing modifications to equip them for future insecticide operations in the United States. These two aircraft, however, were old and six of TAC's better C-123s were selected from those on hand at Pope AFB, North Carolina. The six planes were sent to Olmsted AFB, Pennsylvania, for the installation of MC-1 "Hourglass" spray tanks. Mechanics there also removed all unnecessary equipment; installed aluminum alloy armor plating under and alongside the cockpit; placed in the cargo compartment an engine oil supply replenishment system consisting of a 55-gallon drum, a hand pump, and plumbing to each engine; and added the necessary lines and interconnections to allow the 1,000-gallon spray tank to be used for additional fuel. The SASF placed its other airplanes, with the exception of the two C-123s at Middletown, in flyable storage.²

SASF's six pilots and twelve enlisted men provided the nucleus of the original spray detachment deployed to South Vietnam. Volunteers from Pope AFB supplemented them. Maj. Charles F. Hagerty, then a captain at Pope, recalled that Capt. Carl W. Marshall, the SASF commander, had interviewed people at Pope who had earlier volunteered for Jungle Jim, the Air Force's counterinsurgency force, but who had not been selected to join that organization. Major Hagerty remembered that the Jungle Jim interview, conducted several months earlier, had consisted of ten questions and a "no" answer to any one was disqualifying. The first question was, "Would you go on a mission with extensive TDY?" Their difficulty increased, with the last two questions being something like "Would you wear civilian clothes?" and "Would you go knowing that if you were captured your government would disclaim any knowledge of you?" According to Major Hagerty's recollection, only bachelors were selected for Jungle Jim. (He was married.) However, the names of those who had volunteered were

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retained, forming the pool from which Captain Marshall made his selections for the defoliation mission.³

Captain Marshall experienced no difficulty in obtaining volunteers, in spite of the fact that the men were initially told that they would wear civilian clothes, fly aircraft without USAF markings, and would not be acknowledged as members of the U.S. military if they were captured. The pilots obtained from Pope were experienced in the C-123, but of the fourteen pilots on the first deployment, only eight had experience in aerial spraying. And, with only about two weeks from the time they were selected until they left, there was no time for training until they reached the Philippines.⁴

The personnel selected for the deployment were told they were going TDY to Southeast Asia for some 120 days, but only those with a "need-to-know" found out that their destination was South Vietnam. The men received instructions to tell their families even less—that they would be going on extended temporary duty, but could not reveal their destination. They were also told not to write letters home until they received the "next briefing," which, in the recollection of Major Hagerty, they never received. There was, therefore, no officially sanctioned way for the defoliation personnel to communicate with their families until they returned from Vietnam. As a practical matter, their families learned where the men were and how they were getting along from other Air Force personnel, such as those assigned to the Mule Train C-123 transport unit, who knew the defoliation crews and came into contact with them in South Vietnam.⁵

Including aircrew members and support and maintenance personnel, 19 officers and 50 enlisted men went to Southeast Asia on the original defoliation deployment. Several C-124 transports carried some of the men along with spare parts for the C-123. On November 28, 1961, the six spray-equipped C-123s with 36 persons on board departed Pope AFB for Travis AFB, California. For the purposes of the deployment, they were included under the existing Farm Gate operations plan. On this long overland leg the crews kept careful records of fuel and oil consumption so as to enable them to plan for the extended overwater flights in their route across the Pacific. One hitch in the planning developed because filling the 1,000-gallon internal spray tank with fuel placed the C-123 at about 2,000 pounds over its design gross weight. They were not allowed to exceed this gross weight limit on the first overland leg, but the limit had to be exceeded for the trans-Pacific flight to provide adequate reserve fuel. Therefore, the C-123's pattern of fuel consumption at the higher weight could only be estimated prior to actually flying the leg from Travis to Hickam AFB, Hawaii.⁶

In spite of the earlier talk about "sanitizing" the crews and aircraft, little had been done as they began their deployment flight. The crewmembers

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wore uniforms and were readily identifiable by their names and ranks. The aircraft still carried large "U.S. Air Force" markings and identification numbers. The flight did provide itself with a limited amount of cover by listing fictitious numbers and types of aircraft on flight plans and filing encoded position reports.⁷

In addition, aircraft parking areas at each enroute stop were to have special security arrangements. Obtaining the needed security caused Captain Marshall some degree of difficulty. An earlier message alerting the enroute bases about the special needs of the spray aircraft was evidently either not received or misrouted at some of the bases. This placed Captain Marshall in the difficult position of having to request unusual arrangements upon arrival at each base, while, at the same time, being unable to reveal details of the classified mission which made them necessary.⁸

At 0400, Pacific Standard Time, on November 30, 1961, the six spray aircraft departed Travis AFB for the flight to Hickam. About thirty minutes after takeoff, the number two aircraft experienced icing problems, declared an emergency, and returned immediately to Travis accompanied by the number three aircraft. The remaining four planes proceeded to Hickam along the planned route. They flew at altitudes of 6,000 to 8,000 feet and at an initial speed of 130 knots, when they were heavy with fuel. Their speed increased to about 160 knots as their load lightened, near Hawaii. The heaters were turned off shortly after takeoff to conserve fuel which did not contribute to the aircrew's comfort in the early morning cold. And, in addition, the C-123s lacked autopilots and had to be entirely hand-flown, a factor which contributed to fatigue.

The time en route from Travis to Hickam for the first four aircraft was sixteen hours and thirty minutes. The plane with the least amount of fuel remaining on arrival at Hickam had 3,000 pounds, or enough for about two more hours of flight. This proved the C-123 to be far more capable than had been thought. On the following day, the other two spray aircraft made the crossing in seventeen hours and thirty minutes without further difficulties.⁹

The flight departed Hickam for Johnston Island at 0800 Hawaii time on December 3. After a short refuelling stop, they proceeded to Wake Island. During aircraft inspections there, crewmembers discovered that a cylinder on one engine of the lead aircraft would have to be replaced. Because the necessary aircraft mechanics and spare parts were with the flight, they accomplished the cylinder change in record time. On December 5, the deployment leg between Wake and Guam was traversed without incident. At 0830 on the morning of December 6, the flight took off on the final segment of its journey, Guam to Clark AFB in the Philippines. Some three hours after takeoff, an oil leak developed in the number two engine of the lead aircraft. The crew was able to keep the oil supply in the affected engine at a safe level by using the oil replenishment system installed in the cargo compartment. All six C-123s landed in formation at Clark at 1600 hours on

December 6. They were to remain for a month awaiting orders to enter South Vietnam.¹⁰

Although the delay in the Philippines was frustrating, Captain Marshall used it to advantage. He obtained an area near the coast to practice spray patterns. Chemicals were not used on these practice runs. Some members of the detachment made trips to Saigon in other aircraft to inspect facilities and make plans for beginning operations there. Also during December 1961, a separate operations plan was published for the aerial spray operation, bestowing upon it the name Project Ranch Hand. At this time Ranch Hand's formal organizational title was Tactical Air Force Transport Squadron Provisional 1.¹¹

While the aircraft waited at Clark for clearance to enter South Vietnam, high-level officials were still deciding whether their entry would be overt or covert, and how to handle the public affairs aspects of the operation. Although the final Defense Department recommendation¹² upon which President Kennedy had based his decision authorizing a defoliation operation¹³ called for the overt approach, Secretary McNamara continued to hold open the option of disguising the defoliation program as a South Vietnamese operation. In a meeting with the Joint Chiefs of Staff on November 27, 1961, McNamara had informed the Chiefs of his recommendation to the President that the defoliation program be approved. He had directed them to proceed with planning based on the assumption that the South Vietnamese would conduct crop destruction missions using their own helicopters and that U.S. Air Force aircraft and crews would fly defoliation missions to remove jungle cover. At the same time, he had told the Joint Chiefs to develop an alternate plan whereby the defoliation missions also would be flown under South Vietnamese auspices with their markings on the aircraft and a South Vietnamese officer on the crew as the ostensible "aircraft commander." He had, in addition, directed that no publicity be given to U.S. participation in defoliation or crop destruction operations.¹⁴

In a message dated December 3, Ambassador Nolting in Saigon continued to recommend that the Ranch Hand aircraft carry civilian markings and their crews wear civilian clothes. His recommendation anticipated political problems with the International Control Commission (ICC) established under the Geneva Accords of 1954. The ICC had the authority to inspect shipments of military equipment entering South Vietnam. A shipment of 15,000 pounds of cacodylic acid (blue*) and 20,000 gallons of pink* and green* herbicides for use in crop destruction had by this time arrived unannounced in Saigon by military aircraft, and had bypassed ICC inspection. A

*See Appendix 2, Table 1, p. 199.

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large sea shipment could not be hidden from the commission's scrutiny. Ambassador Nolting was concerned that when the shipment of chemicals for use in defoliation arrived by commercial ship consigned to the MAAG, he would be unable to fit it under an existing ICC credit or justification of title. He therefore recommended that these chemicals be manifested as civilian cargo consigned to the United States Operations Mission (USOM) in South Vietnam, exempting them from inspection. "Civilian" aircraft and crews would, he felt, be necessary to maintain consistency with "civilian" chemicals. He noted that both MAAG and USOM favored this course of action."

The public affairs aspect of the Ranch Hand operation also troubled other high-level policy makers. On December 1, Brig. Gen. Edward Lansdale, an advisor to the Secretary of Defense, penned a warning addressed to Secretary McNamara and Deputy Secretary Gilpatric in which he cautioned them about the potential adverse publicity which could be generated by the planned defoliation operation in Vietnam. Lansdale was concerned about the lack of a "... sound information foundation to assure public support. . . ." He noted that during the Korean War, the communists had been able to convince many people around the world that the U.S. had engaged in biological warfare even though that charge was without foundation. In the case of defoliants in Vietnam, he pointed out that the U.S. would admit to spraying a chemical from the air which kills something (plants) and would therefore be vulnerable to a more serious psychological attack, very likely accompanied by unfavorable reaction from the U.S. media.

Lansdale felt that the existing plan—to have President Diem and his government announce that South Vietnam had asked the United States to spray defoliants—was not strong enough. He predicted that this approach would not be effective in the U.S., among allies, or elsewhere in the world. Diem's image as a "... cornered and power-mad dictator . . ." made such a request from him an insufficient public justification for the program. General Lansdale concluded his memorandum by suggesting that either he or a working group from the Department of Defense set about immediately to plan "... effective psychological support . . ." for the defoliation program. In his opinion there were good reasons for using defoliants and they should be presented, allowing the U.S. to undertake the defoliation program with much more firmness."

Three days after Lansdale wrote his memo, Eugene M. Zuckert, the Secretary of the Air Force, sent a letter to Secretary McNamara expressing similar sentiments. Secretary Zuckert told the Secretary of Defense that he was "... seriously concerned . . ." about the lack of a specific assignment of responsibility for the development of cover stories for some of the planned or contemplated Vietnam operations. He mentioned specifically the current preparations for the defoliation operation which had resulted in ad hoc and uncoordinated public statements. Like Lansdale, he cited the

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biological and chemical warfare implications of the Ranch Hand operation which the communists were already exploiting and stated his belief that "... we are dealing with a high degree of psychological warfare" Secretary Zuckert noted that his staff had talked with General Lansdale and William P. Bundy, the Deputy Assistant Secretary of Defense for International Security Affairs, who both agreed that the public relations aspect of the defoliation program was inadequately covered. He closed his letter by calling for a well-developed plan with a clear point of authority responsible for preventing the release of conflicting stories.¹⁷

On the 12th of December, a memorandum sent to William P. Bundy by Philip F. Hilbert, the Deputy for Requirements Review in the Office of the Under Secretary of the Air Force, indicated that the Air Force position on the manner of introducing Ranch Hand aircraft had hardened against the covert approach. Mr. Hilbert noted that "we" (presumably the civilian leadership of the Air Force) had been disturbed by Ambassador Nolting's December 3 message recommending the airplanes be introduced bearing civilian markings with the crews wearing civilian clothing. It would be possible, Hilbert conceded, for the U.S. to transfer title to the aircraft to the South Vietnamese or to develop some other cover, although the unique nature of the spray-equipped C-123s would clearly indicate that they had come from the U.S. Air Force. However, Hilbert maintained, "... the status of the crews in these circumstances would require considerable thought to insure that adequate protection both to the U.S. and to the individual was provided" In regard to spraying and transport activities, the Air Force position was: "... we believe that the C-123 units can best be used in an overt role in which there is no question of the status of crews or aircraft" Air Force wishes were heeded, for, on December 14, 1961 a joint State-Defense message announced that "... the identity of United States crews and aircraft participating in the spraying operations of the defoliation program will not be disguised"¹⁸

The question of the covert or overt status of the Ranch Hand aircraft and crews had been settled, but Ambassador Nolting's problems with the ICC still had to be addressed. On January 4, 1962, Deputy Secretary of Defense Gilpatric responded to Secretary Zuckert's letter and set out the future Defense Department policy covering public relations and security aspects of Vietnam operations. He stated that the United States and the South Vietnamese had a "... good, legally sound . . . " public justification for challenges to the increased level of U.S. military aid. This justification was that North Vietnam had committed acts of aggression against South Vietnam in flagrant violation of the Geneva Accords and that the United States was responding to South Vietnamese requests to assist it in legitimate self-defense measures. Accordingly, Secretary Gilpatric informed the Joint Chiefs of Staff and the Secretaries of the Army, Navy, and Air Force that future arrivals of U.S. personnel and equipment would not be

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announced by the South Vietnamese government to the ICC; nor would the United States admit that the Geneva Accords were being violated. American officials would respond to questions with the following statement:

The United States has acceded to GVN's request for expanded aid in men and material and is determined to help preserve its independence. This is the sole objective of the United States. The United States will terminate these measures as soon as North Vietnam ends its acts of aggression."

Secretary Zuckert's concern over the lack of a central point of responsibility for developing cover stories or public explanations for U.S. activities in Vietnam was answered by the designation of the Chairman of the Joint Chiefs of Staff as the official responsible for such matters, in coordination with affected Service Secretaries and the Assistant Secretary of Defense for Public Affairs. However, the Secretary of Defense would have to approve all proposed cover stories, explanations, statements of no comment, or combinations thereof. Thus, defoliation program concerns led to a restatement of the U.S. policy toward the Geneva Accords, the removal of ICC inspection power over shipments of U.S. military personnel and equipment, and the designation of a central point of authority for developing cover stories for U.S. operations in South Vietnam.²⁰

On December 4, 1961, the Secretary of Defense met with the Joint Chiefs of Staff and set December 15 as the target date for beginning defoliation operations. At the same time, he granted his prior approval for the defoliation of "key routes," with the proviso that CINCPAC submit detailed plans and the Joint Chiefs approve them. Secretary McNamara, however, asked to be informed when these "key route" plans were submitted and approved.²¹

In addition to the previously discussed problem of developing a public relations approach to the Ranch Hand program, delays encountered in shipping chemicals to South Vietnam and producing a final target list kept the Joint Chiefs from meeting the target date. The shipment of the chemicals proved to be the most formidable obstacle to immediate commencement of spray operations. Twenty thousand gallons of pink and green herbicides and fifteen thousand pounds of cacodylic acid were already in Saigon. They had been sent for use in a crop destruction operation which waited for President Kennedy's approval and which could not then be conducted because that year's rice crop had already matured in the target areas. The Defense Department was procuring additional chemicals for Ranch Hand use in the defoliation of Viet Cong base areas, border regions, and transportation routes. These chemicals, 80,000 gallons of pink and 128,000 gallons of purple, combined with the shipment earmarked for crop destruction, cost about \$2.5 million, or about \$11 per gallon.

The acquisition of defoliants occurred on an expedited basis. As rapidly as truckload lots accumulated, shipments left the factories for the docks at Oakland, California, where port workers loaded 111,000 gallons of purple and 49,000 gallons of pink on the SS *Sooner State* which sailed for

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Saigon on December 15, 1961 and arrived on January 8, 1962. The remaining chemicals, 17,000 gallons of purple and 31,000 gallons of pink, were loaded on the USNS *S.O. Bland* which had a sailing date later in December. The drums carried no military markings and were consigned only to "Country 77," a shipping designation for Vietnam.²²

The option of airlifting some of these defoliation chemicals received consideration for a time. Headquarters, USAF alerted the Military Air Transport Service to ready twenty-five C-124 Globemaster transports to airlift, over the weekend of December 16-17, the chemicals awaiting shipment on the *Bland*. The airlift, however, was not ordered, perhaps because final mission plans for the use of the chemicals had yet to be developed and approved.²³

On December 16, 1961 Secretary McNamara held a conference in Hawaii with Pacific area military commanders. The conference provided him with another opportunity to examine Ranch Hand preparations and make further decisions affecting the operations. Background documents prepared for this conference noted that Thirteenth Air Force and the Ranch Hand detachment had been alerted and were capable of beginning defoliant operations in South Vietnam within 24 hours of receiving orders to do so. General McGarr, head of the MAAG in Saigon, informed Secretary McNamara during the conference that a joint U.S.-Vietnamese planning committee was selecting key routes to be defoliated and expected to complete its work by December 20. Vietnamese authorities had designated one individual from the J3 (operations) section of their Joint General Staff (JGS) to work with U.S. officials to develop detailed plans, and an initial meeting had taken place on December 8. He noted that the development of a final plan was being "aggressively pursued."

McNamara explained that the defoliants would be used initially in road clearing because the chemicals presented a "ticklish" problem and road clearance offered the least potential trouble. He stated his desire to see the project get underway quickly, but he did not think it would be necessary to airlift the defoliants. Secretary McNamara also observed that he would be liberal in interpreting the phrase "key routes." Defoliants could be applied, he said, around ammunition storage sites and Jungle Jim operating locations as well as along roads and trails. He anticipated quick approval of specific defoliation plans once they were submitted.²⁴

Obtaining the final approval for the initial defoliation missions was not as simple a matter as Secretary McNamara had indicated in his meeting with the Joint Chiefs on December 4. Admiral Felt forwarded the plan to the JCS on December 28, 1961, and the Chiefs added their approval in a memo to the Secretary of Defense on January 2, 1962. They noted that an implementing message was ready for dispatch upon the receipt of his approval and notice of final interagency coordination by the Assistant Secretary of Defense for International Security Affairs. The plan as finally approved by the Departments of State and Defense called for defoliating areas to a depth

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of 200 meters on both sides of about 300 miles of strategic roads north and northeast of Saigon. The ultimate goal was to reduce the Viet Cong presence in Zone D, one of their most secure base areas. By clearing vegetation along these roads, the potential for ambushes would lessen, thereby opening lines of communication.²⁵

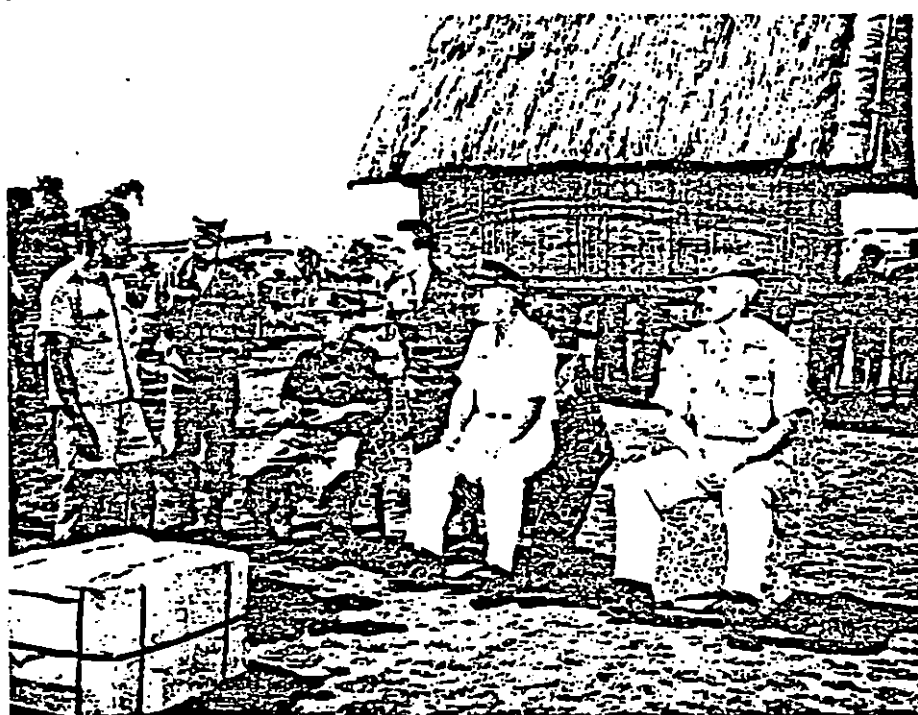
Secretary McNamara did not approve the plan as routinely as he had indicated earlier. Instead, he sought President Kennedy's concurrence. Severely paring the proposal, on January 3, 1962, Kennedy authorized limited operations of an experimental nature against separate targets which together comprised about 16 of the almost 60 miles along Route 15 between Bien Hoa and Vung Tau. Thus, the last barrier in Washington blocking the start of the Ranch Hand program fell, but the way this last decision was reached demonstrated again the extreme caution toward the use of defoliants initially displayed by leaders at the highest levels of American government.²⁶

The directive to deploy three of the six Ranch Hand C-123s to Saigon without delay reached Clark in the early hours on January 7. At 0900 that same day, the aircraft departed the Philippines, arriving at Tan Son Nhut outside Saigon at 1630 in the afternoon. The crews parked the Ranch Hand planes in a secure fenced area on the field, sharing the space normally occupied by President Diem's personal aircraft. They then settled in at the field as, initially, all Ranch Hand personnel were restricted to the confines of Tan Son Nhut and quartered in an on-base "tent city" near the runway.²⁷

Final preparation for the first missions occupied the next several days. On the night of January 8, the *Sooner State* arrived at Saigon with the chemicals to be used on the road clearing missions; off-loading of the drums began on the 9th. Photo reconnaissance missions along Route 15 during these two days double-checked target information previously obtained from maps and ground surveys. Ranch Hand and VNAF pilots received briefings on the 9th to lay the basis for teamwork and coordination during the upcoming spray missions. Also on the 9th, province chiefs and representatives of interested South Vietnamese government agencies held a meeting to review plans for warning the local population and countering Viet Cong propaganda. On the 3rd, Secretary of State Dean Rusk had cabled instructions to the American Embassy in Saigon to "... make no advance announcement other than local warnings, in low key, to population which will witness process. . . ." The South Vietnamese maintained that they would need three days to psychologically prepare the people in the target areas.²⁸

In spite of Rusk's wishes, the South Vietnamese government released the following announcement on January 10, and it appeared the next day in South Vietnamese newspapers:

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Top: Sec. Zuckert congratulates Gen. LeMay on his appointment as Chief of Staff, May 22, 1961; bottom, l. to r. Col. Manh, Gen. Anthis, and Col. Rogers confer with Montagnard province chiefs.

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SAIGON (VP)—The Republic of Vietnam today announced plans to conduct an experiment to rid certain key communications routes of thick, tropical vegetation. U.S. assistance has been sought to aid Vietnamese personnel in this undertaking.

The purpose of this operation is to improve the country's economy by permitting free communications along these routes and by making additional land available for cultivation and other uses. In addition, it will facilitate the Vietnamese Army's task of keeping these avenues of communication free of Viet Cong harassments.

Commercial weed-killing chemicals will be used in experiments. These chemicals are used widely in North America, Europe, Africa, and the USSR for such purposes as ridding corn fields of weeds, renovating weed-infested grazing pastures and clearing irrigation ditches.

The chemical will be supplied by the United States at the request of the Vietnamese Government. The Government emphasized that neither of the two chemicals is toxic, and that neither will harm wild life, domestic animals, human beings, or the soil. There will be little, if any, effect on plants outside the sprayed strip.

If the results of this initial operation are satisfactory, extensive operations will be conducted to clear roads and railroads linking key cities of Vietnam. Clearance of tropical growth along these routes will ease greatly the task of maintaining road systems and railroad beds and will permit the construction of new roads.¹⁹

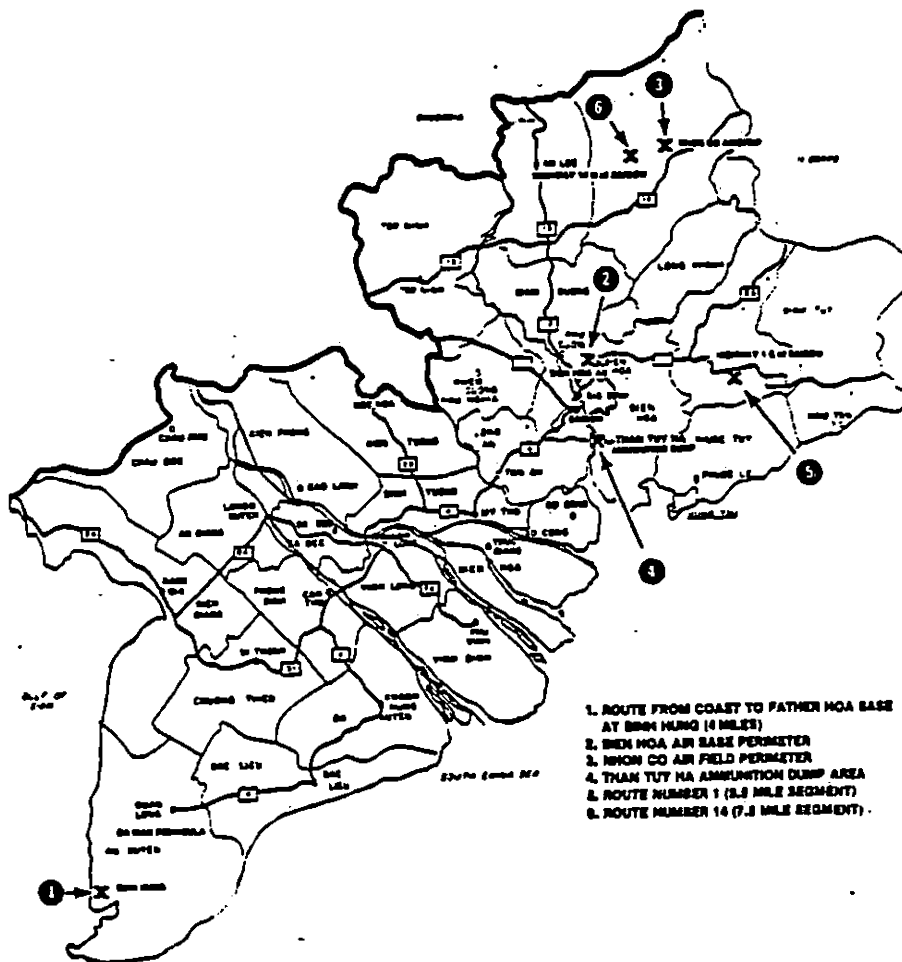
Ranch Hand pilots flew familiarization flights over the target areas along Route 15 on January 10 and 11 to determine specific checkpoints for precision in turning the spray on and off so as to avoid inadvertently spraying crops. The first defoliant was actually released from an Air Force C-123 during one of these flights on January 10. On January 9, Dr. James W. Brown, a scientist from the U.S. Army Chemical Corps Biological Laboratories at Fort Detrick, Maryland, who was responsible for the scientific aspects of the early stages of the defoliation program, had asked Brigadier General Rollen H. Anthis, the commander of 2d ADVON (Air Force headquarters in South Vietnam), to authorize a mission the next day. Dr. Brown felt that a functional pretest would be necessary before formally beginning the test series because neither the purple defoliant nor the C-123 with the Hourglass spray system had been used in Vietnam before, nor had a spray-equipped C-123 been used to deliver this specific chemical mixture. That afternoon Air Force personnel loaded four drums of purple herbicide (about 200 gallons) on one of the Ranch Hand C-123s for a flight the next morning. The spray target was north of Route 15, adjacent to a swath which a VNAF C-47 had sprayed with pink on December 29. The flight took place as planned on the morning of January 10, 1962, with the Ranch Hand C-123 spraying less than the full 200 gallons on the target. The effect of the spray was later rated as poor, probably because the spray deposit was sublethal. The purple herbicide, however, did dissolve the rubber seals in the spray system, requiring their replacement with neoprene seals which were unaffected by the chemical. These familiarization flights left the Ranch Hand aircraft and crews ready to begin formal operations on the 13th.²⁰

FIRST RANCH HAND MISSIONS 10-16 JAN 1962



INITIAL DEFOLIATION OPERATIONS

RANCH HAND TARGETS 14-17 FEB 1962



Capt. Carl Marshall and Capt. William F. Robinson, Jr., flew the two missions along Route 15 on January 13, 1962 which formally inaugurated the Ranch Hand program. They sprayed the first load between 0805 and 0825 from an altitude of 150 feet at an airspeed of 130 knots. The tank discharged its 960 gallons of purple herbicide in a total of 490 seconds of actual spraying time, for a flow rate of about .8 gallons per acre. The distance between flight centers (swath width) was 500 feet for the first flight, but the crew decreased this to 400 feet for the second flight because the heavy herbicide sank faster than expected, reducing the width of the area on the ground covered by a single spray application. The narrower swath width prevented gaps between sprayed areas. Captains Marshall and Robinson delivered the second load between 0940 and 0955 using a different C-123 and a higher pump pressure. This time the total "spray-on" time to expend the 960 gallons was 450 seconds, resulting in a flow rate of about 1.05 gallons per acre. During this run, the pilot of an observation plane flying slightly above the spray aircraft reported that some of the spray was rising rather than sinking to the ground—it was being deposited on his windshield. The sun had been up long enough to warm the air near the ground, disrupting the early morning temperature inversion and generating thermal updrafts which dissipated the spray rather than allowing it to fall on the target vegetation. Dr. Brown and the Ranch Hand personnel were well aware of the need to spray only during inversion conditions which lasted from shortly before sunset to shortly after sunrise, but they evidently had difficulty, initially, in getting this point across to some of the other U.S. officials in South Vietnam.¹¹

Immediately, 2d ADVON reported these first two missions as completely successful, at least from a spray delivery standpoint. It would take time to determine the effect of the defoliant on the target vegetation. In ideal weather, the Ranch Hand pilots encountered no problems in acquiring the targets, enabling them to dispense the defoliant precisely over the areas previously designated by the Vietnamese authorities. ARVN armored vehicles patrolled the entire length of Route 15 during the spray operations but reported no Viet Cong ground fire. In addition, VNAF AD-6s provided fighter cover for both sorties. A Farm Gate SC-47 dropped 65,000 leaflets along Route 15 and made voice broadcasts over the towns of Baria and Long Thanh. Vietnamese observers, photographers, representatives from the MAAG, and Dr. Brown were passengers on these first missions. As on future spray missions, a Vietnamese was on board as the "aircraft commander," but he exercised no real authority.¹²

The first series of Ranch Hand missions along Route 15 continued for three days, and 2d ADVON reported them all as completely successful. As on the first day, armored vehicles patrolled Route 15 and VNAF AD-6s provided fighter cover; they noted no enemy military activity. The mission on the 16th completed the initial authorized spray work which, in ten sorties, used 7,920 gallons of herbicide and covered 6,920 acres. Within hours of the completion of the last mission, Admiral Felt dispatched a message to

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First L target areas namease Joi sible for th marked on not want ti avoid dama especially 2 treated and produced s tion of the proval.¹⁴

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INITIAL DEFOLIATION OPERATIONS

General McGarr in Vietnam informing him that " . . . Wash[ington] D.C. approval necessary before carrying out any defoliant operations beyond those currently authorized. . . . " Ranch Hand was again under very tight high-level control."

The precision required on Ranch Hand missions had highlighted the lack of cartographic information in Vietnam. Old and inaccurate, the small-scale maps made it difficult for Ranch Hand pilots to identify precisely spray-on and spray-off points—a crucial necessity if damage to civilian crops and rubber plantations were to be avoided. To fill this need, Ranch Hand requested 1:25,000 photo coverage of all target areas. RF-101 Voodoo reconnaissance planes flew these photo missions, landing at Tan Son Nhut and providing one copy of their film to Ranch Hand while sending another to Japan for use in making permanent maps.

First Lieutenant Marcus B. Keene, Jr., prepared mosaics of the general target areas from these aerial photos. A representative from the South Vietnamese Joint General Staff took the mosaics to the province chiefs responsible for the areas under consideration. The various province chiefs then marked on the photos the areas they wanted sprayed and the areas they did not want treated with herbicides. Because the province chiefs wanted to avoid damage to their agricultural areas, the Ranch Hand spray missions, especially along roads, were "choppy" and composed of alternate strips of treated and untreated areas. From the marked photos, Lieutenant Keene produced sets of coordinates defining the targets, which the Air Force section of the MAAG then forwarded to higher level commanders for final approval."

The responsibility for flying the C-123 during the crucial spraying part of each mission was shared between the pilot and the copilot. The pilot had control of the switches which started and stopped the spray and which dumped the load of herbicide in an emergency. The responsibility of the aircraft commander on these missions was great—only a few days were needed before the action of the herbicide showed exactly where the load had been delivered there could be no doubt whether the spray had been on or off the target. The copilot was primarily responsible for handling emergencies, such as determining the malfunctioning engine in case of an engine failure, applying power to the good engine, and shutting down the bad one. Considering the low altitude at which Ranch Hand flew, the copilot's reaction in such an emergency had to be immediate and correct the first time; there would be no chance to rectify a mistake. The copilot also had to anticipate pull-ups at the end of each spray run and apply the necessary power for a turn. During the spray run, he kept the airspeed at 130 knots to achieve the planned herbicide application rate."

The role of the South Vietnamese "aircraft commander" was not so clear. He had no actual authority over the mission, and the Ranch Hand crews felt he was carried solely to enable the U.S. to state in the event of criticism that the spray program was "their doings, not ours." At first, the

Ranch Hand personnel thought their Vietnamese "aircraft commander" was a rated pilot, which would have been consistent with his official role. However, on one mission, Captain Marshall, after using much persuasion, coaxed one of them into the left seat so that the Vietnamese could get an idea of what it was like to fly the C-123. His erratic handling of the controls soon convinced the American crew that he was not a pilot, and they subsequently learned that the VNAF had been sending them navigators to fill the U.S. requirement that a Vietnamese be on board for each mission. Later, the VNAF sent anyone who happened to be available, whether officer or enlisted.¹⁶

The conditions under which Ranch Hand operated at first can best be described as ad hoc. Nothing followed established procedures and standards familiar in the U.S., and there was a great deal of improvisation. Coordination with Farm Gate pilots took place at the Majestic Hotel in downtown Saigon for want of a better place at Tan Son Nhut. Current intelligence on enemy emplacements was seldom available to Ranch Hand before their missions, and weather services weren't much better. Major Hagerty recalled landing at one of the fields outside Saigon and meeting an Air Force weather observer who had spent his whole tour in Vietnam without any equipment. When they touched down the weather observer questioned them about the winds and visibility they had experienced and the clouds they had encountered. Then, when the Ranch Hand crew was ready to depart, the weather observer gave them a weather briefing based upon the best information he had, which was simply a recapitulation of what the crew had told him when they landed.¹⁷

Ranch Hand's living conditions were also somewhat haphazard. The officers remained in the on-base tents for about a week before they were allowed to move downtown. Collectively, they rented an apartment building near the Cho Lon area of Saigon for their quarters. The enlisted men remained at Tan Son Nhut. Off base, Ranch Hand personnel were allowed to wear civilian clothes and spend "green" U.S. currency on the local economy. Improvisation provided both conveniences and necessities. For example, the men fabricated their own washing machine out of a 55-gallon drum attached to the rear of a tractor. And, as no safes were available, Lieutenant Keene stored his extensive reconnaissance photo collection in empty aircraft parts containers which were kept under guard. To combat the intense heat, Ranch Hand crews sometimes improvised their own tropical flying gear from t-shirts and bermuda shorts.¹⁸

Ranch Hand was in the curious position of having many bosses—TAC, 2d ADVON, MAAG Vietnam, 13th AF, PACAF—but none who effectively supervised them. Because of the unique nature of their mission, low-level flying and the dispensing of chemical sprays, their immediate chain of command lacked the necessary expertise. As one favorable result, the Ranch Hand unit maintained its integrity and its personnel were not drawn off to work on other missions. However, because their actual work load was

light, only the Ranch Hand command which

Although Ranch Hand magazine has photographed telephoto shots however, to Son Nhut. Their parking Such difficulties compounded primary command for Ranch Hand can Navy of they were sub

During the crews used the come familiar tenth Air Force use the three trial and other sary. . . . " responded with funded, who claims against the aircraft would have a primary herb approval for res was expected spray-equipment

On February aircraft and Fergus C. Grant became the first inaccessible aircraft which reported that had to be escorted they found the into the crew sabotage, engine never official

INITIAL DEFOLIATION OPERATIONS

light, only three or four hours on the few scheduled spraying days, some Ranch Hand pilots tried to obtain flying time with the Mule Train detachment which flew C-123s around South Vietnam on cargo missions."

Although policies varied on the public release of information, the Ranch Hand mission was very sensitive. While a photographer from *Life* magazine had been invited to photograph some of the January missions, a photographer from *Time* created quite a stir when he took unauthorized telephoto shots of the planes in their secure parking area. It was impossible, however, to hide Ranch Hand's nature from people who had access to Tan Son Nhut. The vapors from the herbicide had killed the vegetation around their parking area, including two large flame trees next to their hangar. Such difficulties regarding the public information aspects of their job was compounded by the fact that not all of the members of the American military community in South Vietnam supported their mission. At a party given for Ranch Hand by Ambassador Nolting in about February 1962, an American Navy officer asked how they could manage to sleep at night knowing they were such "violent men."

During the late-January break in operations, Ranch Hand pilots and crews used their available flying time to practice spray techniques and to become familiar with flying over the southern portions of Vietnam. Thirteenth Air Force also requested authority from PACAF during this lull to use the three Ranch Hand aircraft left at Clark for "... mosquito control and other operations in the Philippines as deemed advisable and necessary. . . ." PACAF passed this request to CINCPAC, and Admiral Felt responded with a series of questions about how such operations would be funded, what precautions would be taken to minimize the possibility of claims against the U.S., and what effect the possible need to decontaminate the aircraft plumbing and spray system after mosquito control operations would have on the operational readiness of Ranch Hand aircraft for their primary herbicide mission. The Admiral also noted that Washington approval for resuming and extending defoliation operations in South Vietnam was expected, and that these new operations might require all six of the spray-equipped C-123s currently in the Pacific area."

On February 2, 1962, the six became five as Ranch Hand lost one of its aircraft and crews during a training mission. The aircraft's crew, Capt. Fergus C. Groves, II, Capt. Robert D. Larson, and SSgt Milo B. Coghill, became the first Air Force fatalities in Vietnam. Their plane crashed in an inaccessible area near Route 15 between Bien Hoa and Vung Tau. Another aircraft which circled the crash site immediately after the plane went down reported that the "bad guys" were all over the wreckage. The search party had to be escorted to the crash site by a company of ARVN troops. Arriving they found that someone had removed the plane's spray nozzles and broken into the crewmembers' escape and evasion kits. There was no evidence of sabotage, engine failure, or hits by ground fire; the cause of the crash was never officially fixed. As a result of the crash, however, Thirteenth Air

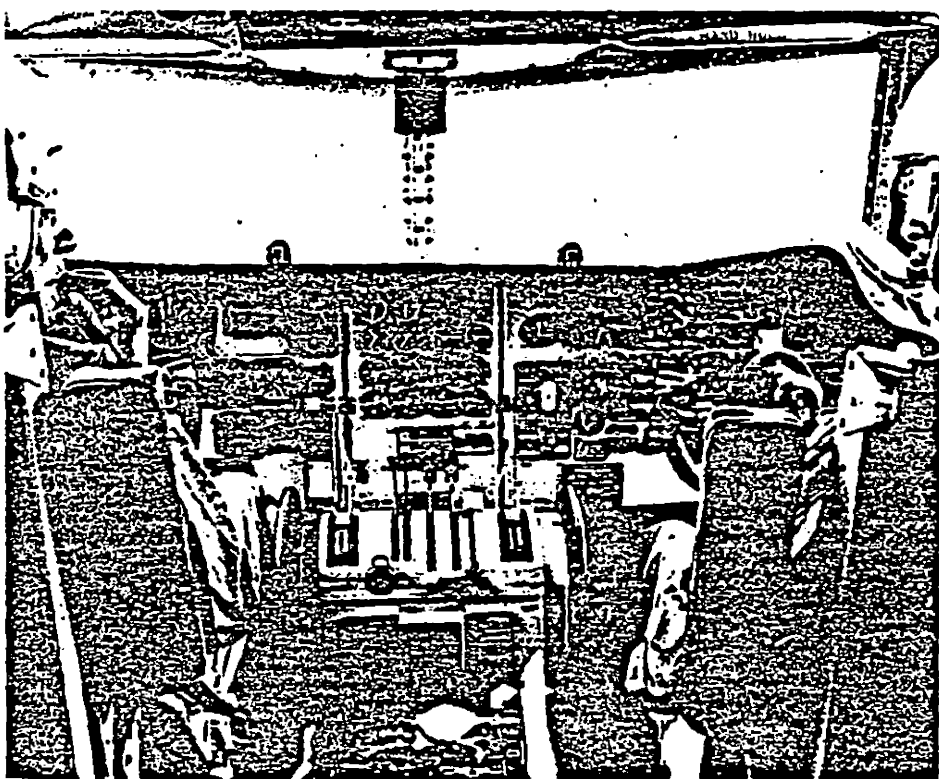
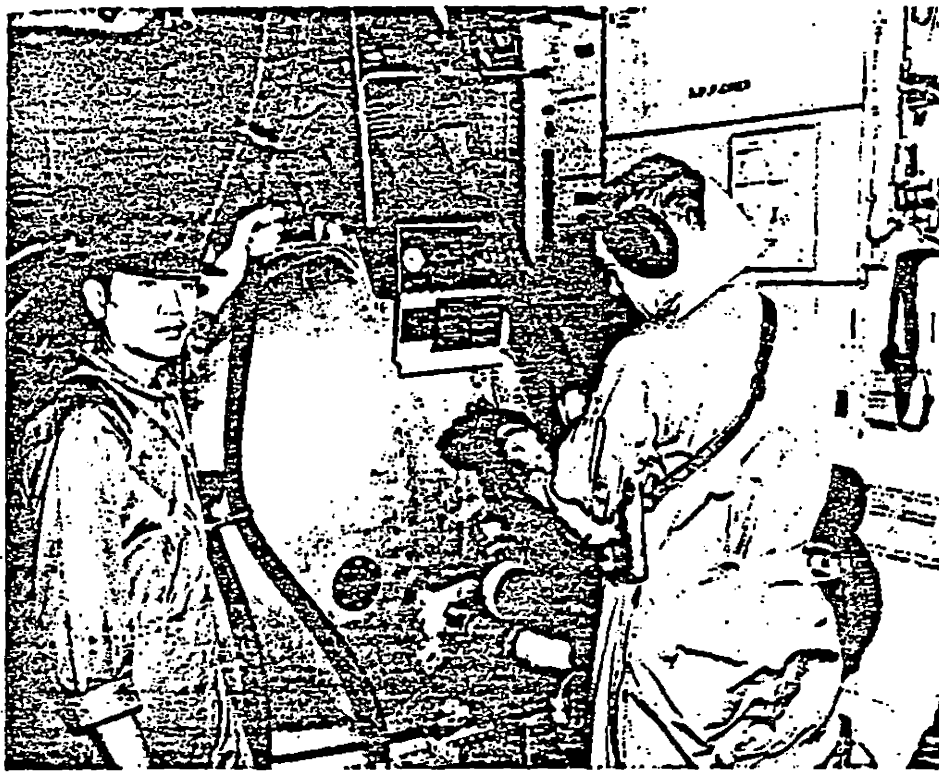


Top: Dr. James W. Brown leads a team checking the results of defoliation in the jungles of South Vietnam, January 1962; bottom: an RF-101 Voodoo reconnaissance plane.

P. 41 (top): a Vietnamese officer (l.) and SSgt Milo B. Coghill, 348th Troop Carrier, Sq., operate a pump aboard a C-123 during a defoliation mission over South Vietnam; bottom: a Ranch Hand cockpit of a UC-123 aircraft in South Vietnam, 1967.



INITIAL DEFOLIATION OPERATIONS



Force requested fighter cover by Farm Gate aircraft for all future Ranch Hand training missions. One of the three C-123s which had been left in the Philippines flew to Tan Son Nhut to return the Ranch Hand strength in South Vietnam to three aircraft.⁴³

Two weeks earlier, on January 15, 1962, Secretary McNamara had convened his Pacific area military commanders in Hawaii for a second conference at which he gave instructions that the next phase of the defoliation program should be a very limited set of experiments to test herbicides and delivery vehicles in a representative variety of terrain and vegetation types encountered in South Vietnam. He wanted these new targets to be specific small areas, not 16 miles of roadway. It would be acceptable to proceed slowly in order to test all spray environments and gather data on the effects of defoliation on combat operations. McNamara tasked Admiral Felt with selecting the test areas and forwarding his recommendations to Washington for approval.⁴⁴ At the conclusion of the conference, Felt cabled General McGarr requesting a list of limited areas containing vegetation types which had not been sprayed during the operations along Route 15. CINCPAC emphasized, as had McNamara, that:

... these additional operations are to be limited in scope and will be conducted solely for purpose of evaluating effectiveness defoliant against different types vegetation under varying conditions.⁴⁵

The answer to this cable came from Vietnam within 36 hours, proposing seven additional areas for defoliation. The two targets heading McGarr's list were stretches of Highway 1 east of Saigon and Highway 14 north of the city. Spraying these two targets would strip the principal species of vegetation present in South Vietnam. The previous areas sprayed along Route 15 had consisted of scrub growth, palmgrove, mangrove, and scattered hardwood trees. The dense rain forest and moderate undergrowth along the Route 14 segment would provide vegetation typical of the plateau region, while the proposed stretch of Route 1 consisted mainly of uncanopied forest containing heavy undergrowth. McGarr also recommended five other areas. One, a mangrove forest in the far southern portion of the Ca Mau peninsula, would be cleared to provide a secure route from the coast to Binh Hung, the home base of Father Hoa—one of the few strong pro-government leaders in the Delta. (Father Hoa was a Catholic priest who had led a group of North Vietnamese to the South at the conclusion of the war between the French and the Viet Minh in 1954.) At that time, cargo had to be dropped to Father Hoa's forces by air, and defoliation would hopefully enable lighters to ferry supplies from ships off the coast without so great a risk of Viet Cong ambush. The other four vegetation enveloped targets were the rapidly expanding Bien Hoa Air Base (to be sprayed by VNAF helicopters), the ammunition dump at Than Tuy Ha, the two Cambodian border outposts at Dinh Tien Hoang and Bu Jamap (considered as one target), and the Nhon Co airstrip.⁴⁶

Admiral Felt's response to this proposal indicated displeasure at the extent of the area to be covered. He noted that the total length of roads to be

cleared came to considerably beyond SECDEF at 15. port initial test Cambodia. How Hoa area and ar McGarr to revise ments of key ro climatic conditio type of vegetatio

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INITIAL DEFOLIATION OPERATIONS

cleared came to approximately 80 miles, and that this would be "... considerably beyond the program of 'very limited character' described by SECDEF at 15 Jan meeting. . . ." Also, he stated that he could not support initial test operations around outposts anywhere near the border with Cambodia. However, Felt was pleased with the targets selected in the Father Hoa area and around ammunition depots and airfields. He directed General McGarr to revise the proposal in order to select "... a few small segments of key routes which will provide the desired variety of growths and climatic conditions. . . ." He imposed a maximum of ten miles for each type of vegetation target."

General McGarr revised his proposal according to these criteria. Admiral Felt concurred and forwarded a more limited plan to Washington for final high-level approval on January 24. By January 27 the plan had gained the approval of General Lemnitzer, acting for the Joint Chiefs, and William P. Bundy, the Deputy Assistant Secretary of Defense for International Security Affairs. However, the approvals of the Secretary of Defense and the President were still needed. Mr. McNamara rejected a draft memorandum for President Kennedy on January 30, because it did not clearly explain the necessity for expanding the experimental spraying program and because he wanted the comments of the Department of State included in the memorandum so that the President would not have to read two papers when one would do. His subordinates made these changes, McNamara added his approval to the plan, forwarding it to the President on February 2."

In his letter to President Kennedy, Mr. McNamara noted that although the initial defoliation operations were over, a second spraying of the areas would be required three weeks after the first. It was too soon to tell how effective the defoliant had been. He also stated that no adverse public relations effects from the first series of tests had appeared in South Vietnam, and that reaction from foreign non-communist nations had been light. As expected, the media reaction in communist nations was hostile. On January 21, Radio Moscow accused the U.S. and South Vietnam of undertaking a chemical warfare program to destroy food. Radio Hanoi broadcasts on January 19 and 24 emphasized the use of toxic chemical sprays to destroy natural resources and crops. Radio Peking issued similar comments. Analysts viewed the communist reaction as the intensification of a propaganda theme begun as early as November 6, 1961.

Secretary McNamara recommended that President Kennedy approve the targets proposed by General McGarr and his staff, with the exception of the Cambodian border outposts and with the total length of areas to be cleared along Routes 1 and 14 reduced to 17 miles. He noted that the Department of State concurred in this recommendation. His justification was as follows:

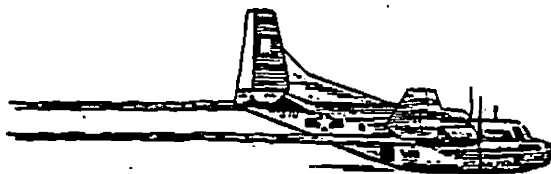
The great variety of vegetation found in Vietnam includes species never treated in previous herbicide tests. The limited areas already sprayed do not include the variety of vegetation and conditions required for a full evaluation of

the effectiveness of the chemicals employed and possible operational concepts for their use. It is important that we test all conditions of vegetation, as well as the effectiveness of defoliant techniques in specific situations, before proceeding with a larger scale program."

Within a few days President Kennedy approved these recommendations, subject to the understanding that the ground rules for the new operations would remain the same as for the first set of targets. The letter communicating the President's approval did not elaborate on these "ground rules," but presumably the President meant to limit additional missions, to keep them experimental in nature, and not to extend them without his specific approval. The Ranch Hand detachment once again had been given a mission to perform, but its actions were still severely limited.¹⁰

Notice of this decision reached Vietnam on February 8, 1962, and the Ranch Hand crews flew the authorized spray missions on February 14-17. On the fourteenth, they sprayed a target along Route 14 which was approximately 10 miles long by 400 yards wide and totalled 1,300 acres. That same day they sprayed about 900 acres surrounding the Nhon Co airfield. Activity on the 15th consisted of spraying a stretch of Route 1 of the same dimensions and area as the target along Route 14 on the previous day. Father Hoa's area was sprayed on the 16th and 17th, with 2,700 acres covered the first day and 1,600 acres on the second. In all, these February operations took 12 sorties, used 154 drums of purple herbicide (about 8,470 gallons), and covered 7,800 acres. The weather was good for all missions, and no hostile activity was observed.¹¹

With the exception of the Bien Hoa airfield and the Than Tuy Ha ammunition storage area which were to be treated by VNAF helicopters, the spray missions on February 17 completed the initial coverage of all the targets authorized by President Kennedy. Ranch Hand aircraft resprayed the areas along Route 15 on March 20 after which date herbicide operations were suspended for five months while the whole spray program was re-evaluated. Ranch Hand was entering an extended period during which its future was very uncertain.¹²



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IV. Early Evaluations and Expanded Operations

Even before the early 1962 herbicide missions ended, American officials at high levels had expressed a great deal of interest in learning the effectiveness of this new chemical counterinsurgency tool. An important argument used in obtaining President Kennedy's approval for these operations had been that they were to be limited experiments. It was, therefore, not surprising that the evaluation of these first Ranch Hand missions received high priority. At the January conference held by the Secretary of Defense in Hawaii, Ambassador Nolting expressed his view that the most valuable potential contribution of defoliants to the war effort would be measured by their success in preventing ambushes. Secretary McNamara, on the other hand, felt that the evaluation of defoliation should address two major questions: first, what will defoliants do to the vegetation native to Vietnam under the variety of conditions found there, and second, what effects does defoliation have on operations?¹

At the next meeting in Hawaii between McNamara and his Pacific area military commanders on February 19, 1962, the effectiveness of the defoliation program was again discussed. A message indicating that the program would be on the agenda passed from the Joint Chiefs to CINCPAC on February 12. The Chiefs stated that defoliant operations were receiving close scrutiny in Washington, and they asked Admiral Felt to send them a detailed report describing the effectiveness of various chemical combinations, types of foliage, and stages of growth. In addition, they requested a realistic appraisal of defoliation in combating the activities of the Viet Cong.² CINCPAC delegated the task of drafting this report to CHMAAG, Vietnam,³ but the scheduled conference took place before he could finish it.⁴

The February discussion in Hawaii concerning Ranch Hand began with a briefing by Maj. Gen. Charles J. Timmes, an Army officer from Vietnam

¹On February 8, 1962, CINCPAC with the approval of his superiors established the U.S. Military Assistance Command, Vietnam (USMACV or MACV) as a subordinate unified command under his control. The Military Assistance Advisory Group, Vietnam (MAAGV) continued to exist until May 15, 1964, but it was made subordinate to MACV in advisory and operational matters. Therefore, after February 8, 1962, the Commander, United States Military Assistance Command, Vietnam (COMUSMACV) was the senior U.S. commander in Vietnam. However, for a time some messages and documents meant for the senior commander were addressed to CHMAAG, probably out of habit. Gen. Paul D. Harkins, USA, served as COMUSMACV from February 8, 1962 until 20 June 1964. On July 1, 1962, Maj. Gen. Charles J. Timmes, USA, became CHMAAG, Vietnam, succeeding Lt. Gen. Lionel C. McGarr, also an Army officer. See Maj. Gen. George S. Eckhardt, *Vietnam Studies: Command and Control 1950-1969*. (Washington: Department of the Army, 1974), pp 25-33, 42, 89.

who would later become Chief of the MAAG there. He reported that 90% to 95% of the sprayed mangroves along Route 15 had lost their leaves. Other vegetation was deteriorating, but since many plants were in their dormant season, the chemicals were less effective. The spray worked well on the mangrove because it grew in swampy areas where the availability of water in both the wet and dry seasons allowed it to grow constantly. Secretary McNamara asked General Timmes if the effect of the chemical on the dormant species should be considered "certain but slow" or simply "uncertain." The general replied that it was "certain but slow."⁴

After hearing this report, Mr. McNamara stated that he was dissatisfied with the results of Ranch Hand. He requested a complete technical report, including photographs before and after the application of the chemicals. This report, he said, should be prepared by a technician who could tell him exactly about the attempts, goals, and results. The Secretary also observed that the defoliation project, in his opinion, had not been managed very well. Although no one criticized the Air Force crews for their handling of the spray missions, General O'Donnell, the PACAF commander, stated that the spray program had been "a blooper from start to finish," presumably agreeing with Secretary McNamara's assessment of the program's management. McNamara emphasized that Ranch Hand was not a scientific experiment for scientific purposes but rather a program intended to affect military operations, and the report he had ordered should state the operational results of the missions.⁵

Ambassador Nolting raised one other topic at this meeting relating to the Ranch Hand program. He reported that the local people had lodged many complaints of damage to their trees and crops. The South Vietnamese had established a board to rule on these claims, but the Viet Cong were readily exploiting the situation and blaming the herbicide missions for any and all dying plants. The Ambassador noted that disallowed claims would antagonize the claimants. Investigations by that time had reduced claims for spray damage to 200,000 Vietnamese piasters (about \$5700).⁶

Within a few days of this February meeting, ground reconnaissance revealed that little or no military advantage had resulted from the January defoliation missions along Route 15, and the U.S. advisors concluded that the trees would have to be destroyed for any useful effect to be achieved. Fighter planes were sent to drop napalm in an unsuccessful attempt to ignite the defoliated areas. The napalm canisters fell through the canopy intact and ignited, with no significant effects, only after hitting the ground. On the other hand, the crowns of the trees did burn when the canisters tumbled on top of the canopy and scattered their load of flaming napalm in the tree-tops. The main problem was that pilots could not consistently drop napalm canisters so that they would tumble on the canopy. Moreover, the fires which did start were not self-sustaining.⁷

Between the February and March meetings with the Secretary of Defense, Gen. Paul D. Harkins, COMUSMACV, issued a preliminary

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evaluation of defoliation based upon detailed ground observation. He concluded that defoliation as yet yielded no military advantage. Improvements in horizontal visibility were negligible, in vertical visibility only slight. Observers noted that the majority of plants in the sprayed areas were alive with many hardy new shoots. Also, they saw some obvious damage to small garden plots belonging to the local Vietnamese, a development the Viet Cong were fully exploiting for its propaganda value. In light of the failure to burn defoliated areas, Harkins felt that hand clearing or bulldozers would have to be used in order to achieve results of any military significance.⁸

At about the same time that Harkins issued his evaluation, Dr. James W. Brown also produced a preliminary report summarizing his work for the Advanced Research Projects Agency (ARPA) on defoliation in South Vietnam covering mid-July 1961 to mid-February 1962. As a scientist, Dr. Brown's views reflected the technical aspects of defoliation and not the impact of the Ranch Hand program on combat operations in the sprayed areas. He concluded:

The chemicals recommended for use, namely, the esters of 2,4-D and 2,4,5-T, are sufficiently active to kill a majority of species encountered in Vietnam if:

- (1) They are applied properly to the vegetation
- (2) They are applied during a period of active growth of the vegetation.⁹

He noted that missions flown by Air Force C-123s had proven that the chemicals would work effectively on actively growing mangrove trees in swampy areas, but that the dormant state of upland vegetation during the December-February dry season had seriously limited the effects of the herbicides. He also cited the lack of calibration of the C-123 spray equipment as a limiting factor in arriving at firm conclusions based on the test areas sprayed to date.

Dr. Brown expanded these views and provided much more background information in the two volumes he wrote on the early defoliation experiments after he returned to the United States. In these later volumes he cited factors he felt had impeded the conduct and evaluation of the tests. He included in those factors the limited expertise available in the Department of Defense on the subject of herbicides, the lack of knowledge among botanists about the species of vegetation encountered in Vietnam, the inhibition on observing the sprayed areas caused by the presence of the Viet Cong, and the timing of the missions with the South Vietnamese growing season. Dr. Brown cautioned that the greatest effect to be expected under any circumstances from chemical sprays would be similar to the condition of a U.S. hardwood forest in winter; that is, the leaves might be gone, but the trunks and branches would remain. Even this condition, he said, would be only temporary in the absence of repeated sprayings, because seeds would give rise to new plants in the defoliated areas, and understory plants which had not been killed would be able to grow rapidly in the sunlight previously blocked by the taller trees.¹⁰

IX. Ranch Hand Ends Its Work

The publication of the MRI report on the ecological effects of herbicides in late 1967 did not dampen the concern of scientists. The Board of Directors of the American Association for the Advancement of Science reviewed the MRI report along with the comments of the National Academy of Sciences and issued a statement of its own in July 1968. The AAAS board agreed that many questions about the ecological effects of herbicides remained unanswered and recommended an international field study under the sponsorship of the United Nations to analyze the long-range effects of the herbicides and to determine what steps should be taken to protect the future of Vietnam's ecology. They were especially concerned about arsenical herbicides, such as agent blue, and urged that the use of this type of herbicide be stopped until more was known about the ultimate fate of the arsenic in these chemicals once it was released on the land. They also called for the declassification of data revealing the dates and locations of herbicide missions and identifying the chemicals applied in each instance to help scientists in their studies. Supplementary statements by various groups of scientists ranged from calling for an end to the entire herbicide program to arguing that using 2,4-D and 2,4,5-T on forests was a military device for saving lives which caused a level of harm to the environment which was unprecedentedly low, presumably compared to alternatives such as high explosives or napalm.¹

In July, to further its call for a United Nations sponsored investigation, the AAAS sent letters to that international body and to the U.S. Departments of State and Defense. The U.N. response was noncommittal, stating only that the Secretary General was paying very close attention to the matter of chemical and bacteriological weapons. The State Department's answer noted that there were differences of opinion even among the members of the AAAS concerning herbicides, but it acknowledged that ultimate effects could only be determined by a long term study in Vietnam. State favored such a study and promised cooperation, but it also noted that, at present, research work in combat areas would be difficult. The Defense Department's reply to the AAAS, signed by Dr. John S. Foster, Jr., the Director of Defense Research and Engineering, agreed with the idea of conducting a systematic scientific investigation of long-range herbicide effects in Vietnam, but only after the return of peaceful conditions to the country had made such studies feasible. Foster said that his department continued to be confident that herbicides would not have a long-term negative impact on South Vietnam's people or interests. On the subject of herbicides containing arsenic, Foster said that Malaysian rubber and oil palm plantations had

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employed them for more than 20 years with no adverse effects at rates five to six times greater than those used in South Vietnam. This AAAS attempt in 1968 to start an extensive scientific investigation failed, but it was by no means the last such effort.³

Shortly after this exchange of letters, on September 18, 1968, the work of the Herbicide Policy Review Committee, which Ambassador Bunker had appointed, was reported to the press in Saigon. Three scientific papers accompanied the press release describing the committee's report, one by Dr. F. H. Tschirley and the other two by Dr. C. E. Minarik and Dr. Robert A. Darrow. Tschirley had made brief air and ground surveys of both mangrove and semideciduous forests. He based his conclusions on his prior experience plus these limited observations. There was no great effect, he said, on higher plants and animals from the increased wind speed and ground temperature in defoliated areas. Some lower life forms dependent on specific microclimatic niches might suffer temporary effects. Tschirley asserted that herbicide use would not significantly hasten the laterization of soil in Vietnam. Only about 30% of the soil was of the type susceptible to laterization, and defoliation did not produce bare dirt which might increase the evaporation rate of ground water, possibly hastening the precipitation of ferrous iron and its oxidization into the insoluble ferric form. Tschirley said that twenty years was a conservative estimate of the time it would take the mangrove areas to return to their original condition. Because of the increasing fish catches near sprayed mangrove forests, herbicides had probably not seriously affected the aquatic food chain. On the other hand, bird and invertebrate populations had probably decreased in mangrove areas. In semideciduous forests, Tschirley found that single sprayings had had no great or lasting effects, but that repeated applications of herbicide would probably have a far greater impact, with the most serious danger being posed by the invasion of bamboo.³

Minarik and Darrow examined the toxicity of the herbicides in use in Vietnam. They quoted the conclusions of the MRI report concerning 2,4-D and 2,4,5-T that the toxicity of these two chemicals was very low, although there might be a problem with fish and fish foods under some conditions. Additionally, they presented data not available to the MRI researchers which showed very little fish toxicity from the dosage of agent orange being used in Vietnam. On the potential danger from agents white and blue, they concluded that neither of these herbicide formulations posed a safety hazard as they were being used in Vietnam.⁴

These same two scientists examined the persistence of herbicides in soil and water and, again, they found no cause for concern. Because of microbial action, the butyl esters of 2,4-D and 2,4,5-T used in orange decomposed rapidly in the soil and disappeared within one to three months at the application rates used in Vietnam. The picloram in white was somewhat more persistent because microbes did not act on it as quickly. Tests in Puerto Rico using direct applications of picloram to soil at rates four to six times greater

than those employed for plant seedlings, so additional tests on seedlings under double application for seventeen months with blue, Minarik and Darrow said crops could be saved at rates greater than those used from defoliated areas. Absorption by vegetation was a breakdown of the toxic in the waters.

In the latter part of 1968, the United Nations Conference adopted, without dissent, a resolution did not mention the passage of time, its ecological issues. Another resolution on chemical, biological, and other factors also considered environmental treaty which the United States had banned "... the use of all analogous methods of warfare by the U.N. Protocol did not apply in the United States vegetation.⁴

Since the AAAS and United Nations organizations on herbicides in Vietnam. At its annual meeting, the AAAS staff to conduct a study. The president in January 1969, requested the ecological effects as soon as conditions permitted, and the organization.

Another pair of scientists, Professor E. O. Wilson, one of the original scientists in the controversy, had been in Vietnam. He viewed the assessment by American

than those employed in Vietnam had shown that only the most sensitive plant seedlings, soybeans, suffered ill effects six to twelve months later. Additional tests on soil taken from targets in Vietnam sprayed with single and double applications of white showed no effects on bean seedlings eleven to seventeen months after the spraying. Concerning the cacodylic acid used in blue, Minarik and Darrow said that field tests had shown that sensitive crops could be safely planted within days of a spraying with blue even at rates greater than those normally used in Vietnam. As to the water draining from defoliated areas, they said that so little herbicide remained after absorption by vegetation, adsorption by soil, and microbial and photochemical breakdown that it was very unlikely that enough would remain to be toxic in the watershed drainage from defoliated areas.³

In the latter part of 1968, the United Nations General Assembly adopted, without objection, a resolution calling for the convening of a United Nations Conference on Human Environment in 1972. While this resolution did not specifically address the question of herbicides in Vietnam, its passage indicated that the world body had become attuned to ecological issues. At about the same time, the General Assembly passed another resolution asking the Secretary General to prepare a report on chemical, biological, and bacteriological weapons. The General Assembly also considered endorsing the Geneva Protocol of 1925, an international treaty which the United States had not ratified. The Geneva Protocol banned "... the use in war of asphyxiating, poisonous, or other gases and all analogous liquids, materials, or devices and of bacteriological methods of warfare." While the U.S. was prepared to support an endorsement by the U.N. of this treaty, the American position was that the Geneva Protocol did not apply to herbicides, chemicals which were used domestically in the United States, USSR, and other countries to control unwanted vegetation.⁴

Since the AAAS had been unsuccessful in its attempts to persuade the United Nations or the United States to sponsor an on-the-spot study of herbicides in Vietnam, the organization decided to attempt such a study itself. At its annual meeting in December 1968, the board of directors asked the AAAS staff to convene an ad hoc group to prepare specific plans for a field study. The president of the association wrote to the Secretary of State in January 1969, requesting his help in assuring that a comprehensive study of the ecological effects of herbicides in Vietnam would be undertaken "as soon as conditions permit." By June no reply had come to this latest AAAS request, and the organization's efforts were temporarily at a standstill.⁵

Another pair of scientists did not wait for the AAAS actions to bear fruit. Professor E. W. Pfeiffer of the University of Montana, one of the original scientists pressing the AAAS to become involved in the herbicide controversy, had consistently called for objective scientific field studies in Vietnam. He viewed the MRI report of 1967 as a "snow job," and the assessment by Ambassador Bunker's committee the following year as too

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general. Besides his activities within the AAAS on the herbicide question, Pfeiffer was also involved in 1968 in an attempt to get the Society for Social Responsibility in Science (SSRS) to organize a study in Vietnam. In late 1968, Pfeiffer announced his intention to conduct a reconnaissance survey in Vietnam under SSRS auspices, and, from March 17 to April 1, 1969, he and Professor G. H. Orians of the University of Washington, Seattle, did conduct limited research in Vietnam. MACV assisted them by allowing them to fly on defoliation missions, inspect sprayed areas from boats and helicopters, and talk with biologists in Saigon. Because of the brevity of the Pfeiffer and Orians visit, the information they collected was mostly restricted to qualitative data and hearsay.

In their preliminary report afterwards, the two scientists acknowledged that a guerrilla war lacking clear battle lines and fixed military targets had the inherent property of causing the destruction of lives and ecological communities as the two sides sought to deny cover and resources and inflict casualties on each other. They reported that the Central Highlands were becoming agent white in a higher proportion than previously because of white's lower volatility. They found no evidence of adverse effects on bird life or mammals from the use of agent blue (cacodylic acid) which had been employed primarily against rice and other crops. Economic costs of herbicide use were in some cases very high, and they cited the costly effects of accidental damage to rubber trees. Also, they determined that the defoliation program posed a potential threat to the South Vietnamese timber industry since repeated applications of herbicide could kill about one half of the commercially valuable trees in the sprayed areas.

Upon his return from Vietnam, Professor Pfeiffer told the press in New York that it was "completely unrealistic" to expect American commanders in Vietnam to stop defoliation missions because the use of these chemicals unquestionably saved American lives. He said that he had seen few living plants on a journey by boat from Saigon to the ocean, but that if the vegetation along the way had not been killed, he would probably not have survived the journey.⁸

As the Nixon Administration began to implement its policy of reducing the American presence in South Vietnam, Ranch Hand came under increasing pressure to cut back on its operations. On August 20, 1969, Adm. John S. McCain, Jr., CINCPAC, requested General Abrams' reaction to a proposal to reduce herbicide operations to 25% of their current level by July 1, 1970.⁹ On September 6, Abrams replied that the planned priority targets in the herbicide program for calendar year 1969 would require as a minimum the current average of four hundred sorties per month. Plans for 1970 were

not yet complete, the border areas requirements near. The accelerating accidental herbicide the current level more likely in the was continually reduced as quickly as the

On September 11, 1969, General Abrams requested a reduction in sorties from 400 to 200 per month. On October 20, 1969, the 12th SFG units along with the spray cause the base had

The remaining operation had a high press coverage a magazine correspondent, and, in January, the unit

On November 1, 1969, the U.S. government's attention to resubmitting the proposal to the S. The firm the standard chemicals and exhibited all uses biological warfare that the Geneva agents. This international Nations when, General Assembly to all chemicals gas. U.S. officials international conference no power to resolve. Still, this to be borne if the

For the per Force to buy \$2.

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not yet complete, but MACV expected continued high demand for defoliating border areas and infiltration routes and spraying enemy crops. Requirements near populated areas would drop as pacification progressed. The accelerating shift to border areas was expected to reduce problems from accidental herbicide damage. Abrams concluded that a reduction to 25% of the current level was unrealistic and that a shrinkage to 70% or 75% was more likely in the period before July 1. He assured his superior that his staff was continually reviewing the herbicide program with the object of reducing it as quickly as the tactical situation would permit.¹⁰

On September 18, 1969, McCain concurred in Abrams' recommendation and requested that herbicide operations be cut by 30% by the following July.¹¹ General Abrams then directed Seventh Air Force to reduce Ranch Hand sorties from the 400-per-month level which was to continue through October, by 20 or 30 sorties per month so as to arrive at a 280-sortie figure for the month of July 1970 and afterwards.¹² To bring the number of spray aircraft into line with these reduced herbicide requirements, in November 1969, the 12th SOS transferred eleven of its twenty-five UC-123Ks to other units along with eleven officers and two flight engineers. At about the same time, the spray planes lost the use of Nha Trang as a turnaround point because the base had been turned over to the VNAF.

The remaining Ranch Hand personnel could probably tell that their operation had a limited future after these reductions were achieved, because press coverage of the controversy over herbicides was increasing. A *Time* magazine correspondent flew two combat sorties with Ranch Hand in November, and, in December, an NBC reporter and television film crew accompanied the unit on two missions.¹³

On November 25, 1969, President Richard M. Nixon announced his intention to resubmit the Geneva Protocol outlawing chemical and biological warfare to the Senate for ratification. At the same time, the President reaffirmed the standing U.S. policy of renouncing the first use of deadly chemicals and extended it to include incapacitating agents. Also, he prohibited all uses of lethal biological weapons and "all other methods of biological warfare." However, it was still the position of the United States that the Geneva Protocol did not apply to herbicides and riot control agents. This interpretation suffered overwhelming rejection by the United Nations when, in December 1969, both a committee and the full U.N. General Assembly adopted resolutions declaring that the protocol applied to all chemicals used in warfare, with no exceptions for herbicides and tear gas. U.S. officials quickly declared that the U.N. action did not reflect an international consensus and that, in any event, the General Assembly had no power to resolve questions of international law such as this by majority vote. Still, this action by the United Nations added to the political burdens to be borne if the herbicide program in South Vietnam were to continue.¹⁴

For the period July 1970 through June 1971, MACV requested the Air Force to buy \$27 million worth of herbicides to support the planned level of

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spray activity. The Department of Defense, however, disapproved the Air Force's herbicide procurement request, cutting it back by almost 90%. Continuing at the then current consumption rate would have exhausted all herbicide stocks by the end of November 1970, Headquarters, United States Air Force asked PACAF and MACV in early February 1970 to comment on three alternatives:

1. Continue spray operations at the present rate until exhausting the supply of herbicides and then withdraw the 12th SOS from South Vietnam.
2. Operate at the present rate through June 1970 and then reduce the 12th SOS to the minimum level needed to meet emergency spray requirements.
3. Reduce the 12th SOS to eight aircraft and ration herbicide missions so as to consume all the herbicide stocks by the end of June 1971.¹⁶

MACV protested the drastic reduction in herbicide operations that the cutback in funding would cause. The view of the American headquarters in Saigon was that the problem of providing an adequate level of surveillance and security in South Vietnam was becoming more critical as American forces withdrew from the country. The Command again cited the fact that tactical commanders credited herbicides with being one of the most economical and effective means of increasing visibility and assisting in the maintenance of the security of lines of communication, widely separated installations, and base camps. If more money could not be found to support herbicide operations at the level originally requested, MACV wanted to use herbicide resources for use only against priority targets. The Ranch Hand aircraft could fly airlift missions when not needed for these priority herbicide targets.¹⁶ Although more money for herbicides was not forthcoming, the Air Force was able to fulfill MACV's request for a continuing capability to spray high priority targets. In late March, Headquarters, United States Air Force directed that the 12th SOS would be reduced to eight aircraft by the end of June. Two of these aircraft were to be configured for spraying insecticides. This force of Ranch Hand planes would be able to meet MACV's priority needs within budgetary limitations.¹⁷

While plans for the reduction in forces went ahead, the problem of ground fire continued to plague Ranch Hand in the early months of 1970. A spray mission of five UC-123Ks over a target in the U Minh Forest on January 19 received fourteen hits from the ground. Less than a week later, over another target in IV Corps, one spray plane had to shut down an engine and land at Binh Thuy because of damage from ground fire. The worst incident of the period occurred on February 21 over a defoliation target along a canal in IV Corps. Three Ranch Hand planes were struck thirty-one times and one of them lost its entire electrical system. Ranch Hand still employed heavy suppression tactics over targets where significant ground fire was likely, but a new wrinkle was tried in early 1970. On a few missions, fighters dropped tear gas bombs on the target ten minutes or less before the spray planes began their run. The fighters then returned and flew ten or fifteen seconds ahead of the UC-123Ks dispensing ordinary explosive CBU's. The use of tear gas in conjunction with Ranch Hand missions soon ended.

On April 6, 1970, five aircraft to Da Nang destroyed crop destruction in the valley of Quang Nam and ten Cobra aircraft over the target on the Ranch Hand weapons fire. The leader of the Da Nang mission through the spray load and flew UC-123K had been 37 hits over the

The controversy over Ranch Hand operations. K. Diane Courtney, Health, had presented, could cause administered in relation Deputy Secretary of Defense that orange pending a decision whether 2,4,5-T could be used. Richard said further that continue, but that the orange must not Ranch Hand operation already taking place in previous year.

Dr. Lee A. DuBridge study questioning the comments and an estimate, the president of the sent their joint report officials, members

The Courtney study had been beginning on June 26, 1970 in that country. See Rpt. The Toxicology, Environmental Dioxin, Oct. 1978,

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On April 6, 1970, Seventh Air Force ordered Ranch Hand to deploy aircraft to Da Nang to augment the four spray planes already there for special crop destruction operation planned for April 10 and 11 in the Be valley of Quang Ngai Province. Four F-100 fighters along with six H-1 and ten Cobra helicopter gunships accompanied this seven-ship formation over the target. Very early in the spray run, enemy gunners opened on the Ranch Hand planes with intense small arms and automatic weapons fire. The lead aircraft, piloted by Lt. Col. Warren P. Fisher, the commander of the Da Nang detachment, lost its right piston engine about midway through the spray run. Colonel Fisher dumped the remainder of his herbicide load and flew to Chu Lai where he made an emergency landing. His UC-123K had been hit twelve times, and the seven planes together received 37 hits over this crop target.¹⁹

The controversy over the use of herbicides also continued as reductions in Ranch Hand operations were argued. In the fall of 1969, a report authored by K. Diane Courtney and others, and prepared for the National Institutes of Health, had presented evidence that 2,4,5-T, a component of herbicide orange, could cause malformed babies and stillbirths in mice when it was administered in relatively high doses.²⁰ In response to this report, the Deputy Secretary of Defense, David Packard, had directed the Joint Chiefs to insure that orange would be sprayed only in areas remote from population pending a decision by the appropriate government agencies about whether 2,4,5-T could remain on the U.S. domestic market. Secretary Packard said further that the normal use of herbicides white or blue could continue, but that the large-scale substitution of these two herbicides for agent orange must not occur.²¹ This restriction did not significantly affect Ranch Hand operations, since most defoliation missions by this time were already taking place in remote areas due to President Thieu's request of the previous year.

Dr. Lee A. DuBridge, the science advisor to President Nixon, referred the study questioning the safety of 2,4,5-T to the Weed Society of America for comments and an evaluation. On December 22, 1969, Glenn C. Klingman, the president of the organization, along with a group of other scientists sent their joint reply to Dr. DuBridge with copies to various government officials, members of Congress, and chemical companies. Klingman's

¹⁹The Courtney study had been preceded by published reports in South Vietnamese newspapers beginning on June 26, 1969, alleging that herbicide orange had caused human birth defects in that country. See Rpt, USAF Occupational and Environmental Health Laboratory, subj: The Toxicology, Environmental Fate, and Human Risk of Herbicide Orange and its Associated Dioxin, Oct. 1978, p V-14.

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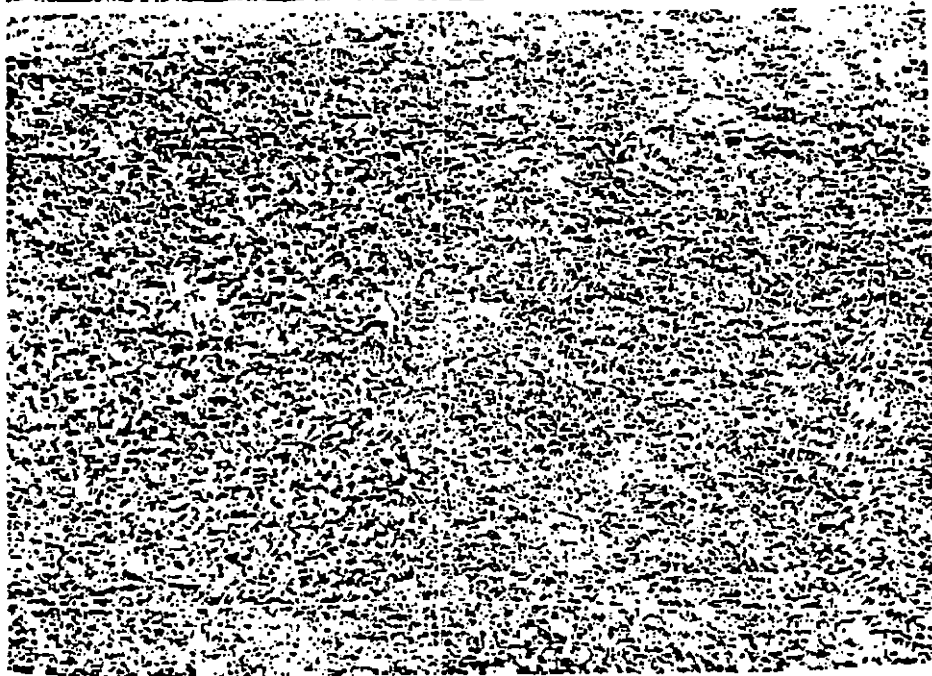
group of reviewers saw multiple problems with using the Courtney study as a basis for determining the hazard to human populations posed by 2,4,5-T. Their first criticism was over the use of dimethylsulfoxide (DMSO) as a solvent for the herbicide in these tests. They said that because DMSO was rapidly absorbed and transported to all parts of the body, it was likely that the 2,4,5-T reached internal organs that it would not have otherwise. Also, they criticized the use of subcutaneous injections as a completely artificial treatment method when compared with natural exposures to 2,4,5-T. In addition, Klingman's group argued that oral dosages used in the test were massive when compared with normal exposures. They concluded that the study by the Courtney group did not support the conclusion that 2,4,5-T contributed to birth defects when used as instructed on the product's label and they advocated a review of the restrictions which had been placed on the herbicide.²²

Within a few days of the Klingman letter, the AAAS adopted an opposing view concerning herbicides in Vietnam. On December 27, 1969, the AAAS Council adopted a resolution which stated that recent studies had shown that both 2,4-D and 2,4,5-T could cause birth deformities in experimental animals, thus supporting the conclusion that 2,4,5-T posed a probable threat to man, while 2,4-D was a possible danger. The AAAS maintained that the levels of application of 2,4-D and 2,4,5-T in Vietnam were greater than the normal dose rates in civilian usage and that these herbicides might be causing birth defects in human babies there. The resolution concluded by calling on the Department of Defense to cease immediately using these two chemicals in Vietnam.²³

On January 19, 1970, an assistant to Dr. DuBridge wrote to Admiral McCain asking for his opinion of the merits of investigating allegations of human birth defects caused by herbicides and pesticides in South Vietnam. McCain replied within a few weeks and said that every reasonable effort should be made to either prove or disprove these allegations. However, he thought it would be difficult, if not impossible, to conduct a study that would have any scientific validity, and the result of an inconclusive effort would simply be to intensify the controversy over herbicides without actually resolving anything. The foremost problem would be collecting data about birth deformities in South Vietnam where few births took place in hospitals and where records were generally incomplete or nonexistent.

McCain also noted that the herbicide program had been under attack in recent years by portions of the U.S. scientific community, antiwar elements and the National Liberation Front (NLF), the political arm of the Viet Cong. He said that rumors of birth defects caused by herbicides had recently become more numerous and that antiwar activists were extensively exploiting the issue. Viet Cong propaganda had been directed toward arousing resentment over the use of herbicides through the spreading of rumors like "... U.S. poison substances have killed fetuses and seriously affected milk secretions of mothers, rendering them unable to feed their babies."

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Top: lawn in front of the U.S. Department of Agriculture, sprayed with 2,4-D to destroy weeds as early as March 1946; bottom: 2,4-D control of weeds—before and after.

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In short, McCain viewed conducting a scientifically valid study of possible birth defects caused by herbicides in Vietnam as completely impracticable. As an alternative, he suggested a study of the possibility of genetic defects from herbicides in the United States where essentially the same compounds had been in use for more than 20 years and where medical records were much better.²⁴

In early April 1970, the Department of Defense learned that on the morning of April 15, the Secretary of Health, Education and Welfare, the Secretary of the Interior, and the Secretary of Agriculture planned to announce in a joint statement, immediate suspension of all use of 2,4,5-T except for carefully controlled and registered applications on non-crop land such as ranges and pastures. The Director of Defense Research and Engineering, Dr. John S. Foster, Jr., informed Secretary of Defense Melvin Laird and reminded him that 2,4,5-T was a major component of the herbicide orange being used in Vietnam at the current rate of 150,000-200,000 gallons per month. Foster noted that agent white could be substituted for orange, but only about 100,000 gallons of white were in Vietnam, enough for approximately fifteen more days of defoliation spraying at the current level of operations. Dow Chemical Company could produce over 200,000 gallons of white if given thirty days to do so. However, Foster pointed out that white was somewhat more expensive than orange and was also more persistent in the soil, increasing the likelihood that long-term ecological damage would result if white replaced orange in large quantities.

As Foster saw the situation, the Defense Department had three choices concerning the future of agent orange. First, it could continue the present policy which stated that this chemical could only be used in areas remote from population. Or, Secretary Laird could endorse the positions of the other three executive departments and direct that orange be applied only to sparsely populated, non-agricultural areas while at the same time avoiding ponds, lakes, and rivers. Finally, Laird could temporarily suspend the use of orange pending further study and the establishment of specific guidelines for future use. Foster argued against the first two options because they would probably cause adverse public reaction. Also, the second option would be confusing without specific criteria for immediate use in answering inquiries. The Chairman of the JCS favored the second option, however, because he felt that restrictions tighter than those governing civilian use of 2,4,5-T should not apply to military uses and because a temporary restriction, once in place, would be very difficult to remove. Foster, on the other hand, favored the last option. He felt it would be quite difficult to establish criteria applicable to civilian uses of 2,4,5-T in the United States to mirror operations in Southeast Asia.²⁵ Foster's view prevailed, and, on April 17, 1970, the Deputy Secretary of Defense informed the Joint Chiefs that: "The Department of Defense will temporarily suspend the use of 2,4,5-T (except in all military operations pending a more thorough evaluation of the situation."²⁶

The JCS messaged both CINCPAC and the JCS, stating that the impact of this decision would be that the ban on the previous policy would be less than a ban. He asked for a substitute. Admiral Laird for herbicide orange or procaine orange in Vietnam.

On May 14, 1970, the JCS, petitioned the President to suspend this as the immediate defoliation. He said that ending the important capabilities, storage locations, military personnel helped to save orange, since defoliation for four weeks with

Because no decision was made, the Chairman of the JCS, the earliest possible decision came on June 1, 1970, announcing that DOD would continue the suspension.

Ranch Hand continued use of the herbicide until April 19. Since orange was previously planned for exhausting stocks of supply at Phu Cat. The JCS ordered UC-123K, and then returned the chemical tank and flew its last mission.

²⁴Between the original American ground operations, including the shuttle opinion costs for training, and the prevalence of any unnecessary costs generated controversy.

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The JCS message directing the suspension of herbicide orange use also asked both CINCPAC and COMUSMACV for their evaluation of the military impact of this action.²⁷ General Abrams replied within days and recommended that the ban on orange be lifted to allow it to be sprayed, as under the previous policy, on enemy-controlled areas with very low population densities (less than eight inhabitants per square kilometer). As an alternative, he asked for 128,000 gallons per month of white or a suitable substitute. Admiral McCain on April 24 reaffirmed the operational requirement for herbicides and endorsed Abrams' call for removing the restriction on orange or procuring a substitute. He also objected to the limitations on orange in Vietnam being greater than those on 2,4,5-T in the United States.²⁸

On May 14, 1970, Admiral Thomas H. Moorer, as acting Chairman of the JCS, petitioned Secretary Laird to lift the temporary ban on orange. He presented this as the best of three options, with the other two being to terminate defoliation operations or to buy enough white to replace the orange. He said that ending all defoliation would take away from General Abrams an important capability to reduce jungle concealment and expose enemy camps, storage locations, and lines of communication. Defoliation enabled fewer military personnel to provide security around fixed installations and had helped to save lives. Moorer did not favor white as a substitute for orange, since defoliation took four months with white as compared to three or four weeks with orange.²⁹

Because no decision was immediately forthcoming, Gen. Earle G. Wheeler, the Chairman of the JCS, wrote to Laird on June 2 asking for the earliest possible decision on the continued use of orange.³⁰ The answer finally came on June 22, 1970, in a JCS message to CINCPAC and MACV announcing that Deputy Secretary of Defense David Packard had decided to continue the suspension of orange.³¹

Ranch Hand received notification of the original prohibition against further use of the herbicide orange through Seventh Air Force channels on April 19. Since orange was no longer available, all defoliation missions previously planned for this herbicide mixture had to be shifted to white. After exhausting stocks of white at Bien Hoa, the unit began drawing down the supply at Phu Cat. The procedure used was to start from Bien Hoa with a loaded UC-123K, spray the target, land at Phu Cat for more fuel and herbicide, and then return to Bien Hoa where the crews parked the planes with their chemical tanks full for the next day's flights. On May 9, 1970, Ranch Hand flew its last defoliation (but not crop destruction) mission of the war,

²⁷Between the original ban on orange and this June decision by Secretary Packard, the American ground operation in Cambodia and the accompanying campus protests in the United States, including the shooting deaths of students at Kent State University, had occurred. The public opinion costs for the Administration in continuing the war in Southeast Asia were increasing, and the prevailing atmosphere was against making any decisions which would generate any unnecessary controversy. Lifting the restrictions on herbicide orange would certainly have generated controversy.

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spraying 2,500 gallons of herbicide white near Bu Nard airfield. At the point, Ranch Hand found itself with nothing to spray. Approved crop targets against which herbicide blue could be used were not yet at a sufficiently advanced stage of maturity.¹²

Since the 12th SOS had no herbicide missions to fly for a while, Seventh Air Force directed the unit to prepare for leaflet drops and flare missions in support of the ground operation which was then underway in Cambodia. Ranch Hand, which by this time had only six herbicide UC-123Ks plus the two used for spraying malathion to control mosquitoes, began leaflet operations on May 11. On May 12, flare drops began over Cambodia. These leaflet and flare missions continued until July 4 and 6, respectively.¹³

Because of the decline in Ranch Hand's herbicide mission and the accompanying reduction in the number of spray aircraft, it became increasingly unnecessary to have a separate squadron devoted solely to this purpose. On July 2, 1970, PACAF approved the inactivation of the 12th SOS. The 315th Tactical Airlift Wing (TAW) then ordered the Ranch Hand planes and crews to relocate from Bien Hoa to Phan Rang where they would become A Flight of the 310th Tactical Airlift Squadron. This move took place on July 8, 9, and 10, and the 12th Special Operations Squadron formally passed out of existence as a separate organization on July 31, 1970.

In early July, Ranch Hand had received word to prepare to resume flying herbicide missions. This presented a problem—the crews had lost some of their proficiency in spray tactics during the previous two months, and some of the newly arrived crew members had no combat experience in spray work. To remedy this situation, Ranch Hand began flying spray training missions from its new base at Phan Rang on July 16, 1970. Another obstacle to future herbicide operations was the fact that the South Vietnamese province chief would not allow Ranch Hand to store herbicide at its home base of Phan Rang longer than overnight. The remaining herbicide stocks were at Da Nang, Phu Cat, and Bien Hoa. As a result, the unit could only fly herbicide missions on alternate days with the intervening day used to fly to one of the storage locations to load herbicides for the next mission.

On July 17, 1970, General Abrams permanently cancelled any future fixed-wing defoliation missions. On July 20, Ranch Hand flew against its first crop destruction target since the break in spray operations in May. On July 22, the unit sprayed another area of crops about 20 miles west of Phan Rang. Ground fire was intense over both of them. To counter ground fire on future missions, Ranch Hand employed heavy suppression. Tactics were also changed. Prior to that time, the planes flying crop destruction missions had maintained a rather loose formation because of the irregular pattern of agricultural fields in the target areas. Individual aircraft might break away completely from the formation to spray isolated fields. After experiencing heavy ground fire in late July, future flights of crop destruction would fly a tighter formation so that the suppression of ground fire by the accompanying fighters would have the greatest possible effect.¹⁴

Another event in South Vietnam was the Advancement of the South Vietnamese Air Force (AVAF) Board of Directors with development of herbicides on a scale of \$80,000 for training to head the same given to this and the literature and equipment, and other such twenty-one investigations.¹⁵

The next stage for a thirty-day survey was informed the would soon be arrived with no official statement. "State also to . . . to deter the Defense Department in South Vietnam that such effort conditions had returned Embassy in Saigon retaining accommodation to the various officials suggested a positive scientists had no of disclosure of classification, officials. Department had clear counter in the war.

Upon their arrival, Dr. John D. C. . . . a Yale assistance from the traveled in helicopter officials and used access to America with Ambassador developed, however spray missions included was at that needed this de

Another event which helped to hasten Ranch Hand's demise was a visit to South Vietnam by a group of scientists from the American Association for the Advancement of Science. At its meeting in December 1969, the AAAS Board of Directors had charged Professor Matthew S. Meselson of Harvard with developing a plan for a study of the effects of the large scale use of herbicides on South Vietnam's ecology and population. The AAAS allocated \$80,000 for the project. Meselson selected Professor Arthur H. Westing to head the AAAS Herbicide Assessment Commission (HAC), the name given to this activity. To begin its work, the HAC reviewed the scientific literature and consulted with knowledgeable individuals from the U.S., Vietnam, and other countries. In June 1970, the HAC held a conference at which twenty-one specialists identified the areas which needed further investigation."

The next stage of the HAC's activities was a trip to Vietnam in August for a thirty-day survey of conditions there. On July 25, the State Department informed the American Embassy in Saigon that a four-man team would soon be arriving from the AAAS, "... a private organization with no official status, but with high standing within scientific community" State also informed Saigon that the purpose of this survey would be "... to determine feasibility of detailed study at a later date" The Defense Department's view, however, was still that the military situation in South Vietnam was not conducive to conducting scientific studies, but that such efforts would be welcomed and supported later after peaceful conditions had returned to the country. The State Department asked the Embassy in Saigon to meet the Meselson group at the airport, assist them in obtaining accommodations and transportation, and provide introductions to the various officials and scientists they desired to meet. Although State suggested a positive approach to this group's visit, it emphasized that these scientists had no official status and that the normal directives governing the disclosure of classified information to private individuals would apply. In addition, officials from the State Department, AID, and the Defense Department had clearly explained the difficulties this survey team would encounter in the wartime conditions prevailing in South Vietnam."

Upon their arrival in Vietnam, Meselson's team, which included Westing, Dr. John D. Constable of the Harvard Medical School, and Robert E. Cook, Jr., a Yale graduate student in ecology, received a great deal of assistance from the American Embassy and MACV. In Vietnam, they traveled in helicopters, small boats, and automobiles provided by American officials and used government facilities for their meals and lodging. Their access to Americans in South Vietnam was extensive, including meetings with Ambassador Bunker and General Abrams. A serious conflict developed, however, over the issue of access to information about specific spray missions including dates, locations, and chemicals used. This information was at that time classified confidential. Meselson's team felt that they needed this data to correlate the samples they collected with the types

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and amounts of spray received in the area. Meselson pressured Embassy officials in Saigon, including Ambassador Bunker, to give the information to him, but MACV and CINCPAC strongly resisted. The MACV information office was suspicious of leaks and the possible inadvertent release of classified information. The office felt that since the Meselson team was working together so closely, showing the data to one of them would be the same as giving it to all four. Following a query by CINCPAC on August 11, the Joint Chiefs reaffirmed the decision not to release classified herbicide mission data to Meselson, citing the additional argument that his team's trip to Vietnam was only a survey visit and that the detailed information he sought would only be applicable to a later, extensive study and not to the feasibility survey he was supposedly doing. Although Meselson did not at that time receive the data he wanted, *Science* magazine published an account of the episode and thereby added to the negative public relations fallout the herbicide program was generating.³⁸

In November 1970, Meselson and Constable wrote to Ambassador Bunker informing him that on August 21 and 28 they had flown over an area of Quang Ngai Province sprayed by Ranch Hand crop destruction missions a few days before. They said that American officials had told them that this was a crop production area for the Viet Cong and the North Vietnamese Army and that most of the destroyed food had been destined for enemy soldiers. Meselson and Constable disagreed with this interpretation, arguing that the number of civilian dwellings in the target area and the number and size of the fields were more consistent with a population of Montagnards growing just enough food to feed themselves. They said that their observations of this one target lent credence to previous studies which had maintained that nearly all of the food destroyed by chemical crop destruction would have been eaten by local civilians rather than enemy soldiers. They strongly urged Ambassador Bunker to review the crop destruction program in light of this challenge to its basic justification.³⁹

Meselson's group presented a preliminary report on their trip to the AAAS meeting on December 30, 1970. They said that their inspection of sprayed mangrove areas had revealed little regeneration of the forest after three or more years. In sprayed tropical hardwood forests, they found large areas of dead trees where bamboo had spread over the forest floor. The bamboo, they feared, would retard the regeneration of the larger trees. They also feared that the sudden death of many trees might have released the plant nutrients contained in the vegetation too quickly and that tropical rains could have carried them away, seriously lowering the soil's fertility. (This phenomenon is known as "nutrient dumping.") Meselson and his colleagues also looked into the possibility that either or both 2,4,5-T and its associated dioxin had caused birth defects in South Vietnam. They found that

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³⁸The data Meselson sought is currently available in unclassified form on the HERB maintained by National Archives Machine Readable Archives Division.

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the existing birth records in South Vietnam were inadequate to either prove or disprove a connection between the herbicide program and birth defects, and they suggested alternate approaches to investigating this question. Finally, the report repeated Meselson's earlier assertion that the civilian population would have consumed nearly all of the food destroyed by the crop destruction program.⁴⁰

With agent orange banned and the fixed-wing defoliation program effectively terminated, it was only a matter of time before the political pressures also put an end to crop destruction, Ranch Hand's remaining mission. On June 16, 1970, Dr. Ivan L. Bennett, Jr., a White House scientific advisor, wrote to Dr. Lee A. DuBridge urging that crop destruction in Vietnam be completely halted. Bennett argued that the Geneva Protocol, soon to be formally submitted to the Senate, would likely become embroiled in controversy over the continued use of tear gas and herbicides in Vietnam. He said that although he had not been able to produce convincing arguments against the military effectiveness of tear gas and herbicides used for defoliation, he thought that the benefits of crop destruction were questionable while the political costs were high.⁴¹ DuBridge endorsed Bennett's view a week later in a letter to Dr. Henry A. Kissinger, the Assistant to the President for National Security Affairs.⁴²

On July 6, 1970, President Nixon himself asked Secretary Laird to assess the value of the herbicide crop destruction program to the overall U.S. military effort in Southeast Asia.⁴³ At the request of the Joint Chiefs, CINCPAC provided a detailed evaluation and justification for crop destruction on July 11. Admiral McCain repeated the claim that crop destruction was an integral part of the resources denial program in South Vietnam and had been since 1962. He said that crop destruction was the most efficient and effective method to keep food which the South Vietnamese could not seize through ground operations from reaching enemy troops. To support his view of the value of crop destruction, McCain cited several incidents, including one in Laos where he attributed a significant role in Gen. Vang Pao's capture of the Plain of Jars to crop destruction missions which had taken place in August 1969. In short, McCain said that both he and Abrams considered crop destruction an essential element of combat support and an important part of the pacification and Vietnamization programs.⁴⁴

Laird replied to Nixon by way of a memo to Kissinger on July 18, 1970. He basically repeated CINCPAC's arguments, stating that herbicides used against crops were an integral part of the resources denial program in I, II and III Corps areas of South Vietnam. He said that crop destruction had

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adversely affected the enemy through lowering morale, increasing defections, and putting an added strain on the supply system. In summary, Linn felt that crop destruction had proven itself "an effective adjunct to our total military effort in Southeast Asia."⁴⁵

President Nixon did not decide to end the crop destruction program at that time, and the political fallout from herbicides continued through the latter part of 1970. During the week of October 19, the American news media reported on an unauthorized use of herbicide orange in the area of operations of the U.S. Army's Americal Division. An investigation by MACV revealed that on several occasions during June, July, and August 1970, personnel of the Americal Division had dispensed approximately 5,500 gallons of orange by hand pump and helicopter spray over remote areas of Quang Tin and Quang Ngai provinces to defoliate base perimeters and to destroy crops. The division chemical officer had ordered the use of orange in violation of MACV directives, but he had done so with the approval of the division's operations officer and had falsified chemical reports to hide his actions. Furthermore, chemical officers at XXIV Corps and MACV had known of the situation but had taken no action either to report it or to stop it. One of the factors which may have led to this unauthorized use of orange was the fact that stocks of white, a substitute for orange, had been depleted in May. New shipments of white did not arrive until October 1970. To prevent such incidents from recurring, all stocks of orange possessed by U.S. units within South Vietnam were consolidated at central storage points where they were under tighter controls.⁴⁶

In early December 1970, Ambassador Bunker and General Abrams decided, on the basis of a report prepared by their staffs in Saigon, to completely phase out the crop destruction program. General Abrams stopped any further procurement of white and blue herbicides. The herbicide stocks on hand in South Vietnam were adequate to defoliate base perimeters and to carry out highly selective crop destruction missions until about May 1971. In accordance with the precedent set when they suspended the fixed wing defoliation portion of the herbicide program earlier in 1970, Bunker and Abrams planned to make no public announcement of their decision to end crop destruction. This, they felt, would allow them to quietly, orderly, and rapidly phase out the program while preserving the option to resume destroying crops in the future if this became necessary.⁴⁷

Additional factors leading to this decision may have included the unsuccessful effort during the summer of 1970 by Senators Gaylord Nelson and Charles Goodell to persuade the Senate to cut off all funds for further crop destruction operations. Although their attempt garnered only twenty-two votes, it did add to the controversy. Also, prior to the Bunker and Abrams decision, a committee of South Vietnamese appointed by President Thieu had concluded that herbicides had destroyed twenty percent of South Vietnam's forests. They had urged President Thieu to ask the Americans to stop the spraying.⁴⁸

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Events in Washington compressed the Bunker-Abrams timetable, however. On November 20, 1970, Dr. Edward E. David, Jr., President Nixon's science advisor and Dr. DuBridge's successor, wrote to Dr. Kissinger and recommended the reconsideration of U.S. herbicide policies in Southeast Asia. David said that he had reason to believe that the AAAS' Herbicide Assessment Commission would report to the Senate Foreign Relations Committee and to the public that the herbicide orange in Vietnam contained a level of dioxin higher than the level permitted for herbicides in use in the United States. Dioxin was at that time known to cause birth defects in experimental animals, and researchers suspected the chemical was able to cause damage to human fetuses if ingested by their mothers in sufficient quantities. Also, David informed Kissinger that all of the candidate substitutes for orange had drawbacks—2,4-D was a suspected carcinogen and picloram was persistent and a soil sterilant. David felt that the current policy combined with these scientific findings might cause trouble during the upcoming hearings on the Geneva Protocol, and he urged Kissinger to propose to Nixon that the U.S. state that it would only spray in Vietnam those chemicals approved for use in the United States under the same governing restrictions."

On December 7, 1970, Secretary Laird informed the Chairman of the JCS and the Secretary of the Army that he had decided to continue to supply the South Vietnamese with both riot control agents and herbicides at a level based on appropriate military and economic considerations." Three days later, Dr. Kissinger asked Secretary Laird to assess the impact of adopting the policy proposed by Dr. David, that is to use herbicides in Vietnam only under the same rules applicable in the United State. Laird asked the Joint Chiefs for their opinion, and they replied on December 18, reiterating their endorsement of the military value of herbicides in Southeast Asia. They said that there were no direct parallels between the ways herbicides had been used in Southeast Asia and normal domestic uses. Complying with the current Department of Agriculture standards of no more than one-half to one part per million (ppm) of dioxin in 2,4,5-T would not be feasible because some of the orange in storage in South Vietnam contained higher levels of dioxin, and no testing facilities existed in Vietnam to determine the level of dioxin contamination in each drum. In any event, the Chiefs argued that the scientific evidence concerning the alleged danger from 2,4,5-T and dioxin was weak and did not justify a continuation of the suspension placed on the use of orange. They cited a study done of a test range at Eglin AFB, Florida, which had received more than 500 pounds of orange per acre over the past eight years, compared with about 25 pounds of herbicide deposited per acre during a single spraying in Vietnam. Investigators had found no detectable dioxin in the soil of this test area, and there were no abnormalities in the animals living there. In short, the JCS saw no factual basis for restricting orange in areas remote from population, and they argued for maintaining the option to continue the herbicide program."

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After receiving the views of the Joint Chiefs, Secretary Laird responded to Dr. Kissinger, but he did not adopt the JCS position. He said that the overall military impact of implementing Dr. David's policy recommendation would be minimal considering that 95% of the South Vietnamese population lived in relatively secure areas and that the rapid progress of the pacification program had made herbicides relatively less important. However, Laird said that the option of conducting future herbicide operations had to be preserved and that the South Vietnamese needed to be provided with the capability to do so. He specifically disagreed with the JCS on the matter of herbicide orange, saying that the adverse political and psychological costs of using the 1.63 million gallons of the chemical then in South Vietnam would outweigh the dollar value of its original purchase price (about \$12 million) and the expense of disposing of it (estimated at over \$6 million). He told Kissinger that he had directed the JCS to produce a plan for disposing of all orange not meeting U.S. Department of Agriculture standards and had decided to continue the ban on orange use pending further studies. Secretary Laird further stated that if President Nixon so directed, he would be willing to apply Department of Agriculture standards to future herbicide operations in South Vietnam.¹²

Three days after the Joint Chiefs sent their first memo on herbicides to Secretary Laird, the Chairman of the JCS sent another stating that the Chiefs did not agree with Laird's announced decision to make the temporary ban on herbicide orange permanent.* Admiral Moorer emphasized again that in the Chief's view every new study had not only failed to support the original suspension of orange, but had shown that the risk of human injury from this herbicide was even less than originally suspected. He also outlined again the problem of disposing of the 1.6 million gallons of orange in Vietnam and the 800,000 gallons in the U.S. He said, "... if, for purely public relations reasons, you determine it necessary to make the ban on orange permanent . . . , " essentially the same techniques used in destroying mustard gas would be needed, at a probable cost in excess of \$10 million."

The protests of the Joint Chiefs were to no avail. On December 22, 1970, Laird informed Nixon that, in the future, the use of herbicides in Vietnam would be in strict conformance with policies governing their use in the United States and that the ban on herbicide orange would remain in effect. He mentioned to the President that Ambassador Bunker and General Abrams had decided on an orderly yet rapid phase-out in spraying other herbicides, but they also retained the option to continue their use if necessary to protect American lives. Laird said that during this phase-out period, herbicide use would be restricted to remote, unpopulated areas and the vicinities of firebases and U.S. installations, limitations similar to those

*Dr. David had proposed this change on December 18.

in force in the U.S. temporary risks to health and use, and he cautioned against increased enemy

Public announcement last week of December 1970 the substance of the possibility of operations." In addition, he wanted any plan to be submitted to the Defense released

Secretary of Defense taken steps to review policies governing the use of herbicides involved in South Vietnam and the States populations.

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*Admiral McMorris stored in the vaults of the Department of Defense and the drug become involved in the decision to use the idea in the major political July 12, 1971.

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in force in the United States. Also, he recognized that there could be some temporary risks to American forces because of these decisions on herbicide use, and he cautioned Nixon that the policy might need to be reassessed if increased enemy activity threatened American forces as they withdrew.⁴⁴

Public announcements of these policy decisions occurred during the last week of December 1970. A White House statement on the 26th revealed the substance of Laird's December 22 memo to Nixon, without mentioning the possibility of reassessing herbicide policy in light of future enemy actions.⁴⁵ In addition, Secretary Laird learned on the 28th that the President wanted any plans to extend or expand the herbicide program or to Vietnamize it submitted for his personal approval.⁴⁶ On the 29th, the Department of Defense released the following statement:

Secretary of Defense Melvin R. Laird has, as we have previously reported, taken steps to insure that herbicide usage in South Vietnam will conform to the policies governing usage in the United States. As a result, the stresses and risks involved in South Vietnam will be no greater than those sustained by the United States population and the United States environment in normal peace-time activities.

Deputy Secretary David Packard last spring restricted all use of defoliant orange, and that ban remains in effect. In addition, at that time use of other defoliants (blue and white) was strictly limited to areas remote from population.

General Abrams is now initiating in South Vietnam an orderly phase out of the herbicide operations to be completed by next spring.

It is important to note that estimated herbicide coverage for 1970 through September is 75 percent less than for the same period in 1969.⁴⁷

During the last quarter of 1970, Ranch Hand flew only forty-three crop destruction sorties, with nineteen in October, eighteen in November, and only six in December. By way of contrast, the two insecticide aircraft flew a total of 133 sorties during this same period.⁴⁸ The last Ranch Hand herbicide mission of the war sprayed a crop target in Ninh Thuan Province on January 7, 1971.⁴⁹ On January 16, Deputy Secretary of Defense David Packard ordered the immediate termination of all crop destruction operations by U.S. forces.⁵⁰ The Joint Chiefs informed CINCPAC of this decision on January 22.⁵¹ Since there was no further mission for Ranch Hand, the 310th TAS absorbed its A Flight spray planes and crews on January 28, 1971. This released the six herbicide spray UC-123Ks for cargo hauling duties. The two insecticide aircraft continued their mosquito spray mission. On February 11, 1971, one of the two crashed, killing all five men aboard.⁵²

⁴⁴Admiral McCain on June 27, 1971, proposed a new use for the herbicides and spray systems stored in South Vietnam—against opium poppies, the source of heroin, which contributed to the drug abuse problem in the United States. The United Nations, he said, might become involved in this effort. The JCS responded on July 3 and stated that they would examine the idea in collaboration with the State Department and the Secretary of Defense, but that major political barriers existed. See Item of Interest AFXOOSO, Maj. R.C. Pyatt, July 12, 1971.

Appendix 2

Summary of Herbicide Operations

TABLE 1.—MAJOR HERBICIDE MIXTURES USED IN VIETNAM

<i>Military Color Code or Trade Name*</i>	<i>Composition (active ingredients)</i>
Pink	60% n-butyl ester of 2,4,5-T 40% isobutyl ester of 2,4,5-T
Green	100% n-butyl ester of 2,4,5-T
Pink-Green mixture	80% n-butyl ester of 2,4,5-T 20% isobutyl ester of 2,4,5-T
Dinoxol	50% butyloxyethanol ester of 2,4-D 50% butyloxyethanol ester of 2,4,5-T
Trinoxol	100% butyloxyethanol ester of 2,4,5-T
Purple	50% n-butyl ester of 2,4-D 30% n-butyl ester of 2,4,5-T 20% isobutyl ester of 2,4,5-T
Blue	100% sodium salt of cacodylic acid
Orange	50% n-butyl ester of 2,4-D 50% n-butyl ester of 2,4,5-T
Orange II	50% n-butyl ester of 2,4-D 50% isooctyl ester of 2,4,5-T
White	80% triisopropanolamine salt of 2,4-D 20% triisopropanolamine salt of picloram

Source: The Committee on the Effects of Herbicides in Vietnam, National Research Council, *The Effects of Herbicides in South Vietnam: Part A* (Washington, D.C.: National Academy of Sciences, 1974), p II-4; rpt, Review and Evaluation of ARPA "Defoliation" Program in South Vietnam [1962], pp 31-32; rpt, Capt. Alvin L. Young, *et al*, USAF Occupational and Environmental Health Laboratory, The Toxicology, Environmental Fate, and Human Risk of Herbicide Orange and Its Associated Dioxin, Oct. 78, p 1-7 (hereafter cited as USAF OEHL Report).

*Herbicide drums were identified by a four-inch-wide circular band of paint colored in correspondence with these color codes.

TABLE 2.—HERBICIDE DISSEMINATED IN SOUTH VIETNAM JAN 1962-DEC 1964

<i>Military Herbicide</i>	<i>Gallons of Formulation</i>	<i>Pounds Active Ingredient</i>
Blue	5,200	10,000
Green	8,208	66,980
Pink	122,792	1,001,980
Purple	145,000	1,180,300
Total	281,200	2,259,260

Source: USAF OEHL Report, p 1-9.

Notes

Chapter I

The Development of a Military Herbicide Capability

1. Eldon W. Downs and George F. Lemmer, "Origins of Aerial Crop Dusting," *Agricultural History*, Vol 39, No 3 (Jul 1965), pp 123-135.
2. Ltr, Chief, Air Corps to Chemical Warfare Technical Committee, subj: Dispersion of Chemicals from Aircraft, Oct 2, 1933.
3. Edward J. Neil, "Gas Stopped Ethiopians: War Correspondent Tells How Airman Burned Enemies' Feet," Associated Press dispatch, 1936, quoted in rpt, "Use of Gas in Ethiopia—1936," Chemical Warfare School, Edgewood Arsenal, MD, undated, pp 1-3.
4. "Selassie Speaks," *Time*, Jul 13, 1936, quoted in rpt, "Use of Gas in Ethiopia—1936," p 6.
5. Col O. B. Schreuder and Capt W. N. Sullivan, "Spraying of DDT from Airplanes," *The Air Surgeon's Bulletin*, Vol 2, No 3 (Mar 1945), pp 67-68.
6. Rpt, Army Air Forces Board, Orlando, FL, "Marking and Defoliation of Tropical Vegetation," Dec 18, 1944.
7. Royal Air Force, *The Malayan Emergency, 1948-1960*, (London: Ministry of Defence, Jun 1970), pp 113-114, 152; U.S. Aerospace Studies Institute, *The Accomplishments of Airpower in the Malayan Emergency (1948-1960)*, (Maxwell AFB, AL: Air University, May 1963), p 57.
8. Rpt, Wright Air Development Center, Wright-Patterson AFB, OH, subj: Engineering Study on a Large Capacity Spray System Installation for Aircraft, Jun 3, 1952.
9. *Ibid.*
10. Technical Study, Kent Irish, Dep Commander, Scientific Activities, Biological Warfare Laboratories, Fort Detrick, MD, "Anticrop Agent Munition Systems," Jul 1958; Dorothy L. Miller, *History of Air Force Participation in the Biological Warfare Program, 1951-1954*, (Historical Division, Air Materiel Command, 1957), pp 117-120.
11. Rpt, Dr. J. W. Brown, U.S. Army Chemical Corps Biological Laboratories, subj: Vegetational Spray Tests in South Vietnam, Supplement, Apr 1962, pp 21-31.
12. John I. Lumpkin and Mary J. Konopnicki, *Military Aerial Spray Operations, 1946-1960*, (HQ TAC Historical Division, ca 1961).
13. Minutes, C-123 Aerial Spray System Preliminary Planning Conf, Langley AFB, VA, Aug 29, 1960.

Chapter II

The Decision to Send Spray-Equipped C-123s to South Vietnam

1. For a detailed discussion of the Kennedy Administration's decision to intervene in South Vietnam, see *United States-Vietnam Relations 1945-1967* (Washington: U.S. Government Printing Office, 1971), Books 2 (TV.B.1), 11 and 12, from which much of this account has been extracted.
2. Memo, W. W. Rostow to the President, no subj, Apr. 12, 1961.
3. Memo, Task Force Draft for the President, subj: A Program of Action to Prevent Communist Domination of South Vietnam, Apr 26, 1961.
4. Ltr, Pres John F. Kennedy to Pres Ngo Dinh Diem, May 8, 1961.
5. NSAM No 52, May 11, 1961.
6. *Ibid.*; memo, Task Force Draft, subj: A Program of Action to Prevent Communist Domination of South Vietnam, pp 4-5.
7. Ltr, Pres Ngo Dinh Diem to Pres John F. Kennedy, May 15, 1961.
8. Ltr, Brig Gen Edward G. Lansdale, Asst SECDEF, to Dir/Defense Research and Engineering (DDR&E), subj: Combat Development and Test Center, Vietnam, May 16, 1961.
9. JCS 2343/3, Status Report on the Presidential Program for Vietnam as of July 10, 1961, Jul 21, 1961.
10. JCS 2343/12, Status Report on the

Presidential Program for Vietnam as of July 21, 1961, Aug 15, 1961. In both of these status reports, paragraph number 20 described activities of the CDTC, including defoliation. Later, defoliation to remove jungle cover came to be known as CDTC Task Number 20, and "20" was often used in the designation of defoliation projects.

11. Rprt, Review and Evaluation of ARPA/OSD "Defoliation" Program in South Vietnam, (1962), App A: Target Evaluation Data, p 1; rpt, author not indicated, subj: Herbicide Operations in the Republic of Vietnam, (1965), Supporting Document #1 of CHECO Report, *Herbicide Operations in Southeast Asia July 1961-June 1967*, p 2; rpt, Dr J. W. Brown, U.S. Army Chemical Corps Biological Laboratories, Fort Detrick, MD, subj: Vegetational Spray Tests in South Vietnam, Apr 1962, pp 9, 10, 39-46. Nine tests of spraying herbicides from the air took place in South Vietnam before the Ranch Hand planes arrived. Seven involved a C-47; one, an AD-6 fighter plane; and one, an H-34 helicopter. See Brown, above, pp 39-45.

12. American advisors found out in the summer of 1961 that the VNAF was using napalm, rockets, and 20-mm guns against rice paddies in an attempt to deny rice to the Viet Cong. This use of ordnance was so unsuccessful that the advisors were able to persuade the VNAF to abandon this tactic. See Reference Book for the Meeting with the Secretary of Defense, Oct. 8, 1962.

13. MR, Office of the Chief, MAAGV, subj: Meeting Held at Independence Palace, Saigon, Vietnam on Friday, Sept 29, 1961 (Adm Feb's Visit), p 22.

14. Memo, U. Alexis Johnson, subj: Concept for Intervention in Vietnam, Oct 10, 1961, with two supplemental notes dated Oct 11, 1961.

15. The GPO edition of the *Pentagon Papers* (cited earlier) on page 79 of Section IV.B.1 (Book 2) describes the U. Alexis Johnson paper as listing only two "Specific Ac-

tions to be Taken Now" concerning Vietnam, neither of which has to do with defoliation. However, the Johnson paper itself lists on pages 7 and 8 five different "Specific Actions to be Taken Now," three of which, including the defoliation proposal, relate specifically to South Vietnam.

16. MR, Roswell L. Gilpatrick, subj: South Vietnam, Oct 11, 1961.

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