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Item ID Number	05271 ☐ **Not Scanned**
Author	
Corporate Author	Comptroller General of the United States
Report/Article Title	Report by the Comptroller General of the United States: Health Effects of Exposure to Herbicide Orange in South Vietnam Should be Resolved
Journal/Book Title	
Year	1979
Month/Day	April 6
Color	☐
Number of Images	0
Description Notes	CED-79-22

REPORT BY THE

Comptroller General

OF THE UNITED STATES

ALVIN L. YOUNG, Major, USAF
Consultant, Environmental Sciences

Health Effects Of Exposure To Herbicide Orange In South Vietnam Should Be Resolved

Since 1977 Vietnam veterans have been contacting the Veterans Administration about health problems which they believe were caused by exposure to herbicides in Vietnam.

Problems in identifying personnel exposed to herbicides and determining the possible health consequences of such exposure have hampered VA efforts to resolve veterans' concerns.

This report recommends that the Department of Defense, with the assistance and guidance of an appropriate interagency group, conduct a survey of any long-term medical effects on military personnel who were likely to have been exposed to herbicides in South Vietnam. It also recommends several additional actions VA and DOD should take.

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COMPTROLLER GENERAL OF THE UNITED STATES
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B-159451

The Honorable Bennett Stewart
House of Representatives

Dear Mr. Stewart:

As agreed on June 28, 1978, with the office of your predecessor, the late Representative Ralph H. Metcalfe, this is the second of the two reports on our review of the Department of Defense's use of herbicides in South Vietnam and veterans' concerns over possible adverse health effects of herbicide exposure.

Our interim report (CED-78-158, Aug. 16, 1978) addressed the (1) extent of the Defense's use of herbicides and other chemicals in South Vietnam, (2) number of military and civilian personnel exposed to these chemicals, and (3) Defense-funded studies of the health effects of these chemicals. This report addresses primarily the Veterans Administration's response to veterans' concerns on herbicide exposure in South Vietnam and health effects studies of TCDD, a highly toxic contaminant of 2,4,5-T, a component of Herbicide Orange.

As arranged with your office, we will make the report available to other interested parties 2 days after the issue date.

Sincerely yours,

Comptroller General
of the United States

COMPTROLLER GENERAL'S
REPORT TO THE HONORABLE
BENNETT STEWART
HOUSE OF REPRESENTATIVES

HEALTH EFFECTS OF EXPOSURE TO HERBICIDE ORANGE IN SOUTH VIETNAM SHOULD BE RESOLVED

D I G E S T

In late 1977, Veterans Administration (VA) regional offices began receiving compensation claims from veterans who felt that some of their medical problems were caused by exposure to herbicides in Vietnam. These problems included such conditions as fatigue, nervousness, cancer, reduced hearing, and birth defects in offspring.

Vietnam veterans also began contacting VA health care facilities, expressing concerns over possible herbicide exposure. By September 1978 about 600 veterans had been examined at VA health care facilities and about 450 had submitted claims to regional offices.

The Department of Defense carried out military herbicide operations in South Vietnam from 1962 to 1971. Herbicides were used primarily for

--defoliating trees and plants to improve observation and

--destroying food crops of hostile forces.

Herbicide Orange, a 50:50 mixture of 2,4-D and 2,4,5-T, was the most widely used herbicide. Concentrations of 2,4,5-T used in South Vietnam were heavier than those used in the United States for various purposes.

The component, 2,4,5-T, contains a contaminant, TCDD (dioxin), that is highly toxic. TCDD's toxic effects have been reported by researchers investigating the effects of continued occupational exposure to chemicals contaminated by TCDD and also acute exposures resulting from industrial

accidents. Its effects on laboratory test animals have been studied; however, long-term health effects on humans remain largely unknown.

VA's actions have been hampered by this lack of information on long-term health effects of herbicides. VA has established an interagency advisory group to assist in evaluating the medical aspects of herbicide exposure. (See p. 13.)

VA has allowed no compensation claims solely on the basis of herbicide exposure. However, one veteran has received benefits for a skin condition existing while he was in the service which VA believes might be related to herbicide exposure. (See p. 11.)

Because there are no specific records on herbicide exposure, VA is having difficulty identifying veterans who were exposed to herbicides. Defense officials believe that those most likely to have been exposed were herbicide handlers and aircraft crews flying herbicide missions. Defense has identified about 500 of these crew members. (See p. 6.)

VA health care facilities have been instructed to examine any veteran concerned about herbicide exposure. Veterans currently being treated in VA facilities and those applying for care will be asked if they have been exposed to herbicides or other chemicals in Vietnam. The results will be included in a data base compiled by VA. (See pp. 11 and 12.)

VA regional offices have been instructed to evaluate herbicide-related claims as they would any other claim for service-connected compensation. However, no assurance is made that all veterans submitting such claims to regional offices are being referred to VA health

care facilities for examination. In addition, VA regional offices have not been instructed to obtain information from military records concerning the likelihood of an individual veteran's exposure to herbicides (for example, occupational specialty, duties performed, locations, and dates in Vietnam). (See p. 12.)

Defense medical facilities may also be receiving patients who are concerned about exposure to herbicides. However, no system exists to determine the extent of these contacts. The Department of the Air Force is the only service to have developed any guidance for its medical facilities to evaluate personnel concerned about herbicide exposure.

RECOMMENDATIONS

The Department of Defense, with the assistance and guidance of an appropriate interagency group, should conduct a survey of any long-term medical effects on military personnel who were likely to have been exposed to herbicides in South Vietnam.

The Secretary should also provide guidance to insure that Air Force, Army, and Navy medical facilities are uniformly monitoring and evaluating possible herbicide-related concerns of personnel who served in Vietnam. In addition, information developed through Defense medical facilities should be coordinated with the VA.

The Administrator of Veterans Affairs should provide guidance to insure that:

--In evaluating herbicide-related claims, regional offices obtain all information from military records pertaining to a veteran's possible exposure to herbicides in Vietnam.

--All veterans submitting such claims to regional offices are encouraged to contact VA health care facilities.

AGENCY COMMENTS

Defense generally agreed with the need to provide guidance to all Defense medical facilities. However, officials doubted that a retrospective epidemiological study of Vietnam veterans would produce reliable results because of various data limitations. GAO recognizes that there would be limitations on a study of Vietnam veterans, but believes it would be desirable to obtain information related to the herbicides as used in Vietnam. (See pp. 27 and 28.)

VA agreed that all veterans submitting herbicide-related claims should be referred to VA medical facilities, and VA regional offices should obtain information on the veterans' possible exposure to herbicides. (See p. 16.)

Contents

ABBREVIATIONS

EPA	Environmental Protection Agency
GAO	General Accounting Office
IARC	International Agency for Research on Cancer
NAS	National Academy of Sciences
NIEHS	National Institute of Environmental Health Sciences
µg/kg	microgram (chemical) per kilogram body weight (animal)
ppb	parts per billion
ppt	parts per trillion
VA	Veterans Administration

CHAPTER 1

PERSPECTIVE

By letter dated April 10, 1978, the late Representative Ralph H. Metcalfe expressed concern about possible long-range adverse health effects on individuals that were exposed to Herbicide Orange. He requested that we examine certain aspects of the Department of Defense's use of herbicides in Vietnam and the Veterans Administration (VA) handling of disability claims submitted by herbicide-exposed Vietnam veterans. As agreed with the Representative's office on June 28, 1978, we issued an interim report (CED-78-158, Aug. 16, 1978) which addressed (1) the extent of the Defense's use of herbicides and other chemicals in South Vietnam, (2) the number of military and civilian personnel exposed to these chemicals, and (3) the Defense-funded studies of the health effects of these chemicals.

This report addresses primarily VA's response to veterans' concerns on herbicide exposure in South Vietnam and health effects studies of TCDD. We conducted our review at the Washington, D.C., headquarters offices of the Department of Defense, Environmental Protection Agency (EPA), and VA; and at the VA regional office and Hines Hospital in Chicago, Illinois. We examined pertinent legislation, instructions, studies, reports, and other documents. In addition, we talked with officials of Defense, EPA, VA, the National Academy of Sciences (NAS), the National Institute for Occupational Safety and Health, and the National Cancer Institute.

MILITARY USE OF HERBICIDES AND OTHER CHEMICALS IN SOUTH VIETNAM

Defense field tested herbicides in Vietnam in 1961 and carried out military herbicide operations from 1962 to 1971. The herbicides were used primarily for (1) defoliating trees and plants to improve observation and (2) destroying food crops of hostile forces. The herbicides used were:

--Herbicide Orange, a 50:50 mixture of 2,4-D and 2,4,5-T, was the most widely used herbicide in Vietnam. The component 2,4,5-T contains a

contaminant, TCDD (2,3,7,8-tetrachlorodibenzo-para-dioxin) which is one of most toxic chemicals known.

--Herbicide Purple (a similar mixture of 2,4-D and 2,4,5-T that contained a different form of 2,4,5-T--it was replaced by Herbicide Orange in 1964). 1/

--Herbicide White (a mixture of 2,4-D and Picloram).

--Herbicide Blue (cacodylic acid).

The military use of herbicides in Vietnam is detailed in appendix I.

According to a Defense estimate, about 17.7 million gallons of herbicides were sprayed during the 1962 to 1971 period. From 1965 to 1971, Defense sprayed 10.65 million gallons of Herbicide Orange, 5.63 million gallons of Herbicide White, and 1.14 million gallons of Herbicide Blue. NAS estimated that of the 3.6 million acres sprayed, 66 percent was sprayed once, 22 percent was sprayed twice, 8 percent was sprayed three times, and 4 percent was sprayed four or more times. NAS estimates of the quantities sprayed annually and application rates are summarized in appendix II.

Herbicide Orange was sprayed undiluted in Vietnam at the rate of about 3 gallons (containing 12 pounds of 2,4-D and 13.8 pounds of 2,4,5-T) per acre. Civilian applications of this herbicide's components are usually diluted in oil or water. According to industry officials, the civilian application rate of 2,4,5-T varies from 1 to 4 pounds per acre. A Defense official said that the heavier application was needed to assure success of the herbicide operations. Defense officials also stated that due to the dense jungle canopy, the amount of herbicide penetrating the forest floor would have been similar to those normally applied to brush infested ranch land in the United States.

1/ Other herbicides used primarily during the 1962-1964 period included about 130,000 gallons of Herbicides Pink and Green. Both herbicides were formulations containing 2,4,5-T.

In October 1969 Defense restricted the use of Herbicide Orange to areas remote from population. This action was prompted by a National Institutes of Health report that 2,4,5-T could cause malformations and stillbirths in mice. Researchers later attributed similar problems to the contaminant TCDD, which is produced during the manufacture of 2,4,5-T. In April 1970 Defense suspended all use of Herbicide Orange in Vietnam. About the same time, the Department of Agriculture restricted certain domestic uses of 2,4,5-T because of its possible health hazards.

In 1971 Defense directed the Air Force to dispose of all remaining stocks of Herbicide Orange. These stocks contained TCDD contaminant levels ranging from less than 0.02 to 47 parts per million and averaging about 1.98 parts per million. 1/ Current manufacturing standards for 2,4,5-T require TCDD levels to be less than 0.1 part per million. The Air Force reported that Herbicide Orange was disposed of by high temperature incineration at sea in 1977.

The fate of TCDD in the environment

TCDD has had the reputation of being very stable and persistent except when dissolved in organic solvents, such as methanol and benzene, and exposed to ultraviolet light. An experiment reported in March 1977 concluded, however, that despite the known persistence of pure TCDD, it is not stable as a contaminant in thin herbicide films exposed to outdoor light.

According to NAS, TCDD is insoluble in water, slightly soluble in fats, slightly more soluble in hydrocarbons, and somewhat more soluble in chlorinated organic solvents. TCDD is stable to heat, acids, and alkali. Thermal decomposition requires a temperature of at least 1500° Fahrenheit. Studies have indicated that TCDD is immobile in soils and has a half-life in soil of about 1 year. TCDD exerts its biological effects at extremely low concentrations. This has posed serious limitations on analytical work with the substance.

1/Since Herbicide Orange is a 50:50 mixture of 2,4-D and 2,4,5-T, an average TCDD contaminant level of 2 parts per million would indicate that the 2,4,5-T component, as manufactured, contained TCDD levels averaging about 4 parts per million.

Scientists involved in measuring samples for TCDD have calculated that a sensitivity of about 1 part per trillion (ppt) is required for environmental monitoring of TCDD.

Studies at Eglin Air Force Base Reservation in Florida

The Air Force sprayed massive amounts of herbicides over approximately 1 square mile at Eglin to test aerial dissemination systems. The testing area was divided into four grids, three of which were sprayed with 2,4,5-T. Grid number one containing 92 acres, was sprayed with about 87,000 pounds of 2,4,5-T (947 pounds per acre) during 1962-64. Grids two and four were sprayed in 1964-66 and 1968-69, respectively, with substantially lesser amounts of 2,4,5-T per acre of grid area.

Between 1973 and 1978, the Air Force collected 54 soil samples from the test grids. It detected levels of TCDD in the range of less than 10 ppt (minimum detection level) to 1,500 ppt. The median concentration was 30 ppt, while the mean was 165 ppt. In an October 1978 report, the Air Force attributed the wide fluctuation in TCDD concentrations to the locations of the actual flight paths on the test grid. The Air Force also said that it was apparent that the herbicides applied during 1962 to 1964 contained very high levels of the TCDD contaminant.

The Air Force, in its October 1978 report, noted that its ecological survey documented the presence of more than 123 different plant species, 77 bird species, 71 insect families, 20 fish species, 18 reptile species, 18 mammal species, 12 amphibian species, and 2 mollusk species. At least 170 biological samples were analyzed for TCDD, including 30 species of animals. No TCDD was found of the plant species examined. However, TCDD was found in nine species of animals including two rodent species: beachmice (300 to 1,500 ppt, liver) and hispid cotton rat (less than 10 to 210 ppt, liver); three species of birds: meadowlark (100 to 1,020 ppt, liver) mourning dove (50 ppt, liver) and Savannah sparrows (69 ppt, liver); three species of fish: spotted sunfish (85 ppt, liver), mosquito fish (12 ppt, whole body), and sailfin shiner (12 ppt, whole body); and one reptile, the six-lined racerunner (360-430 ppt, muscle).

Other studies

1. Samples of fish, crustaceans, and human milk from areas of South Vietnam heavily treated with 2,4,5-T in the military herbicide program were analyzed for TCDD. Unconfirmed levels of 18 to 810 ppt in fish and crustaceans and 40 to 50 ppt in human milk were found in samples collected in 1970 shortly after large scale use of Herbicide Orange was ordered discontinued. (Reported by Dr. Robert Baughman and Matthew Meselson, Harvard University, 1973 and 1975.)

2. Thin layers of Herbicide Orange containing 15 parts per million of TCDD were exposed to California summer sunlight in glass petri dishes. Identical treatments, masked from sunlight, served as dark controls. Loss of the TCDD was rapid in sunlight, and less than half remained after 6 hours. Herbicide Orange also was applied evenly in droplets over leaves of a rubber plant and on the surface of loam soil and exposed to sunlight. TCDD was lost even more rapidly from the leaf surface than from glass while loss from soil was slower.

   According to the authors, their measurements indicated sunlight is the principal factor in TCDD disappearance from inert surfaces, plants, and soils treated with TCDD-contaminated pesticides. They also stated that in every experiment, light caused the TCDD content to decline sharply, while dark controls remained virtually unaffected.

   The authors concluded that there were three requirements for significant TCDD breakdown: dissolution in a light transmitting film; the presence of an organic hydrogen-donor such as solvent or pesticide; and ultraviolet light. According to the authors, all three conditions normally should have been met consistently during the practical application of 2,4,5-T and, consequently, their data

suggests environmental residues of TCDD often will be considerably less than previously expected (Donald G. Crosby and Anthony S. Wong, University of California, Davis, 1976).

3. A 1977 study of the distribution, persistence, and mobility of TCDD found that once TCDD volatilized, it degraded in direct sunlight and apparently even in shade outdoors. However, the researchers did not find as rapid degradation on grass as Crosby found on excised leaves. In addition, they found that TCDD degradation in air was considerable but not as great as Crosby's data suggested. (Ralph G. Nash and M. Leroy Beall, Jr., 1977.)

Other chemicals used in South Vietnam

A Defense official said that malathion and DDT were the other principal pesticides used in Vietnam; they were used throughout the war for mosquito control. Malathion was sprayed by aircraft, and DDT was applied by backpack and paint brush. Defense stated that ground forces were routinely exposed to aerially applied insecticides such as malithion and could have confused this with direct exposure to herbicides. An official said that no information is readily available on the quantities used in Vietnam.

Malathion is still used domestically for insect control. However, in 1972 EPA canceled all except public health and quarantine uses of DDT because of its persistence, biomagnification, and toxicological effects.

PERSONNEL EXPOSURE TO HERBICIDES

A Defense report shows that about 2.6 million military personnel served in South Vietnam from January 1, 1965, to March 31, 1973. Defense records indicate that the number of U.S. civilian personnel employed by Defense in South Vietnam ranged from 49 in March 1965 to 1,522 in September 1969 --cumulative data on civilians is not readily available. Defense has little information, however, on the number of personnel exposed to herbicides in Vietnam. Defense officials stated that (1) no such personnel records were maintained, (2) it would be difficult to estimate meaningful exposure data because the potential for exposure

varied widely among personnel, and (3) only a few military personnel would have been exposed directly to spraying. Some personnel could have been exposed indirectly to low levels of herbicides through ingestion of contaminated drinking water and food and by skin contact. However, Defense stated that indirect exposure through ingestion of food and water was unlikely because subsistence was not generally obtained from local sources.

According to Defense, military personnel did not enter areas treated with Herbicide Orange in most instances until 4 to 6 weeks after treatment, thereby greatly minimizing their chances of contacting or inhaling the herbicide. Personnel involved in actual "dedrumming" of the herbicides and spraying missions (particularly crewchiefs and flight mechanics) were more likely to have been exposed than others. Defense has identified about 500 aircraft crew members involved in herbicide missions.

CURRENT CONCERNS OVER EFFECTS OF 2,4,5-T and TCDD

Extensive media coverage has been given to purported adverse health effects of 2,4,5-T and TCDD. For example, in March 1978, a CBS-owned affiliate in Chicago aired a special report on Herbicide Orange.

In late 1977 veterans started making inquiries of the Chicago VA regional office on the possible effects of herbicide exposure. Some filed claims for VA compensation alleging that their medical problems were caused by herbicide exposure in Vietnam. As of September 1978 veterans had filed an estimated 450 claims nationwide, including about 255 at the VA regional office in Chicago.

In an April 12, 1978, news release EPA, which has the responsibility for regulating such pesticides as 2,4,5-T, said that about 450 letters had been received from citizens and environmental groups protesting the domestic use of 2,4,5-T. The herbicide 2,4,5-T was used domestically for brush control on livestock grazing land, on right-of-way areas and in forests, and for weed control in rice. Use of 2,4,5-T is prohibited around homes; recreational sites and aquatic areas; and in crops, except rice, used for human consumption. In a Federal Register notice dated April 21, 1978, EPA announced that it was reevaluating the registered uses of pesticides containing 2,4,5-T (43 FR 17116, et seq.).

EPA stated in its announcement that 2,4,5-T and/or its contaminant, TCDD, exceed the risk criteria for oncogenicity (the quality of being able to cause tumor formation) and for teratogenic (causing congenital malformations) and/or fetotoxic (causing harm to fetus) effects as set forth in its regulations. The announcement invited interested parties to submit rebuttals and other information on the findings and to submit any other data on the risks and benefits of this pesticide chemical.

On March 1, 1979, EPA announced emergency action to halt the spraying of 2,4,5-T on forests, pastures, and rights-of-way because of new information indicating its potential link to human miscarriages. This emergency suspension action is similar to a temporary restraining order issued by a court. This action reflects EPA's belief that there is sufficient evidence to stop further exposure to 2,4,5-T until health questions can be resolved.

CHAPTER 2

FEDERAL RESPONSE TO HERBICIDE CONCERNS OF VIETNAM VETERANS

VA began receiving herbicide-related compensation claims in late 1977. As of October 1978 VA has allowed no compensation claims solely on the basis of herbicide exposure in Vietnam. However, one veteran did receive benefits for a skin condition existing inservice which VA believes may have been related to herbicide exposure.

Actions to resolve individual herbicide claims and develop overall policy have been hampered by inconclusive information on the long-term health effects of herbicides and problems in identifying the veterans exposed to chemicals during military service. These medical and exposure uncertainties have made it difficult for VA to define the relationship between chemical exposure in Vietnam and health problems currently experienced by veterans.

SCOPE AND CHARACTERISTICS OF VETERANS' CONCERNS

Fifty-eight VA regional offices are responsible for receiving and adjudicating service-connected compensation claims. As of September 1978 an estimated 450 herbicide-related compensation claims had been filed at regional offices within the contiguous United States. Over half of these claims (about 255) originated in the Chicago regional office. The New York and Seattle regional offices received the second largest number of claims--about 18 each.

We reviewed about 120 of the herbicide-related cases at the Chicago regional office to determine the types of illnesses veterans are associating with herbicide exposure. The most commonly indicated concerns are categorized below as a percentage of total cases reviewed:

Illness	Percent
Skin conditions	50
Fatigue and/or nervousness	32
Numbness of extremities	28
Vision and/or hearing impairment	17
Birth defects in offspring	13
Reduced libido	13

Less frequently cited concerns included miscarriages by spouse, impotency, respiratory problems, and gastro-intestinal problems. In addition, about six cases associated cancer with herbicide exposure. In about 10 percent of the cases, no specific concerns could be identified.

In addition to filing compensation claims at regional offices, veterans have also contacted VA hospitals or other VA health care facilities. As of September 1978 about 600 veterans had been examined by VA health care facilities concerning herbicide exposure. Of the 172 VA hospitals, Hines Hospital in Chicago, Illinois, examined the most veterans--84. Martinez (California) and Chicago Westside examined the second and third highest number--54 and 47, respectively.

Officials at Hines Hospital told us that a large number of veterans contacting them about herbicide exposure were concerned about rashes, others were concerned about nervousness, and some said they were experiencing numbness. In addition, some veterans had no specific illness but were interested only in obtaining information on the possible ill effects of herbicide exposure.

VA ACTIONS ON THE HERBICIDE ISSUE

In response to concerns about herbicide exposure, VA has issued guidelines for its health care facilities and regional offices, initiated internal studies, and established various working groups to study herbicide related illnesses and formulate policy. However, VA action to resolve individual compensation claims and develop overall policy have been hampered by a lack of information in several areas. For example, VA officials stated that little data is available on what the long term health effects are of Herbicide Orange. Another official pointed out that some of the health problems associated with herbicide exposure, such as fatigue, are not unique enough to diagnose the problem's cause. Because of

the medical uncertainties, it becomes difficult for VA to associate current illnesses with herbicide exposure in Vietnam. VA guidance to regional offices and health care facilities reflects these uncertainties and acknowledges that currently the only chronic illness known to be caused by herbicide exposure is a skin condition called chloracne.

As with health effects information, little data is available to identify personnel exposed to herbicides in Vietnam. VA has been unable to find specific reference to herbicide exposure in individual military service records. As an alternative, VA is attempting to obtain information on the possibility of an individual veteran's exposure to herbicides in Vietnam. In a September 18, 1978, letter to the Department of Defense, VA requested complete maps of herbicide missions, dates they were carried out, units spraying the herbicides, and units in sprayed area at the time of the mission or entering afterwards. As a result of this request, Defense agreed to provide VA with the names of aircraft crew members involved in herbicide operations, and computer printouts and maps of the spraying missions in South Vietnam.

As of October 1978 VA had evaluated about 90 compensation claims for herbicide exposure and awarded benefits in about 8 cases. However, only one of these awards, a service-connected skin condition, was linked to possible herbicide exposure. The remaining claims were awarded for reasons not related to herbicide exposure.

Instructions to VA health care facilities

Principal guidance for VA hospitals and other health care facilities is contained in a May 1978 teletype and September 1978 circular. VA's general policy is to examine and treat all veterans claiming toxic effects from exposure to herbicides during the Vietnam War. In addition, all veterans who are currently being treated in VA facilities or who apply for care will be asked if they have been exposed to herbicides or other chemicals in Vietnam. These instructions also provide guidance for developing record keeping systems and submitting quarterly reports to VA headquarters.

In examining veterans concerned about herbicide exposure, health care facilities have been instructed to pay particular attention to the kidneys, liver, thyroid,

adrenals, gonads, skin, lungs, nervous system, blood-forming system, and immune system. In addition, medical histories are to include information on possible reduced libido, frequent abortions, sterility, congenital deformities among children, neoplasia, chloracne, and repeated infections. The health facilities also will solicit information on the time, place, and extent of possible exposure to chemicals regardless of when it took place. This and other information will be used in a data base being compiled on possible effects of herbicide exposure. VA has also arranged for the Armed Forces Institute of Pathology to receive and store specimens removed at VA medical centers from Vietnam veterans possibly exposed to herbicides.

Instructions to VA regional offices

In an April 1978 directive, VA instructed its regional offices to evaluate herbicide-related claims in the same manner as other claims for service-connected compensation. In general, disabilities can be service-connected for either immediate or delayed effects that are shown to be a direct result of incurrence while in service.

Under current procedures, a herbicide-related compensation claim can be administratively denied for two reasons. One is if the veteran does not claim a disability but is only concerned with possible exposure to herbicides. The second is if a veteran claims genetic damage which VA states is not provided for under the law.

VA regional offices have been instructed to send copies of completed ratings of herbicide-related claims to headquarters for review. In addition, regional offices have been instructed to request information from a veteran's service record to verify herbicide exposure. However, service records normally do not contain specific information on chemical exposure. As a result, responses to such requests are neither verified nor denied by military service records' personnel. Currently, VA regional offices have not been instructed to obtain other information from military records which may assist in determining the possibility of exposure to herbicides (e.g. occupational specialty, duties performed, unit, locations, and dates while in Vietnam).

There are no special instructions to regional offices regarding if and when a veteran submitting a herbicide-related claim should be referred to a VA health care facility. About 33 percent of the 50 final ratings we reviewed had no indication of a recent VA physical examination.

VA herbicide committees' activities and internal studies

The VA has formed three committees to deal with scientific and policy questions related to the herbicide issue. Policy guidance has been provided by an in-house steering committee which first met in June 1978. Assisting them is an interagency group known as the Interagency Committee on Herbicides. It functions as a factfinding, advisory group and was developed to explore:

--the potential adverse health effects of defoliants on Vietnam veterans, including symptoms associated with these effects,

--methods for diagnosing and treating the adverse health effects of defoliants, and

--approaches through which the VA might discover the prevalence of adverse effects of defoliants used in Vietnam on its patient population.

VA has requested that an advisory committee composed of Federal and non-Federal members be formally chartered. The interagency committee will be absorbed by the new advisory committee if approval is granted for its establishment. As of January 1979 the group had not been formally chartered.

In October 1978 VA established a third committee to evaluate herbicide cases received by VA health care facilities. The committee is composed of specialists in various disciplines, such as internal medicine, neurology, and psychiatry. This committee and the interagency committee report through the steering committee.

In addition to committee activities, VA medical officials are reviewing past patient treatment files to determine if there is an increased cancer rate among Vietnam era veterans. As of September 1978 no conclusions have been

drawn from this review. VA medical officials also plan to examine past records of compensation claims for skin conditions to determine if they may have been related to herbicide exposure in Vietnam.

VA also is sponsoring a study to determine if dioxin levels in 10 Vietnam veterans possibly exposed to herbicides are higher than levels found in personnel who were not exposed. This study is not expected to be completed before September 1979.

DEFENSE INVOLVEMENT IN THE HERBICIDE ISSUE

In October 1978 Defense testified before the Veterans' Affairs Committee of the House of Representatives that there was little or no relationship between many alleged symptoms and past exposure to Herbicide Orange in Vietnam. Its testimony was based on a recent review of the use of herbicides in Vietnam and scientific literature pertaining to the toxicological effects of these herbicides. The results of its review were published in an October 1978 Air Force report entitled "The Toxicology, Environmental Fate, and Human Risk of Herbicide Orange and Its Associated Dioxin." Defense has, however, offered assistance to VA and has representatives on the interagency committee.

The Department of the Air Force is the only service to have developed any guidance for its medical facilities regarding the evaluation of military personnel who might be concerned about herbicide exposure. None of the services have monitoring systems for such personnel. As a result, the extent of concern related to possible herbicide exposure among active military personnel is unknown.

CONCLUSIONS

VA is dealing with a sensitive issue that is complicated by a number of medical uncertainties. It has taken steps toward resolving these questions through analyzing available research information and initiating new research. However, additional measures could be taken to provide VA with a better basis for evaluating the nature of herbicide concerns expressed by veterans.

VA has not fully utilized information in military records to determine a veteran's possible exposure to herbicides in Vietnam. Although the records normally do not

contain unequivocal verification of herbicide exposure, they do contain information that may reflect on the likelihood of exposure. However, VA regional offices have been instructed to obtain only verification of exposure from service records and not necessarily information on the likelihood of exposure. In view of the absence of unequivocal verification of herbicide exposure, we believe that VA regional offices should attempt to obtain all information from military records which may reflect on a veteran's likelihood of exposure to herbicides in Vietnam.

In addition, under current VA policy, all veterans who contact VA health care facilities regarding possible health complications due to herbicide exposure will be examined, and the results will be included in a data base. However, veterans contacting regional offices in regard to compensation claims may or may not be referred to a VA health care facility. As a result, VA physical examination and inclusion in the data base are partially dependent on whether the veteran contacts a regional office or a health care facility.

Similar to VA health care facilities, Defense medical facilities also may be receiving contacts from military personnel concerned about exposure to herbicides in Vietnam. However, there is no system to determine the extent of these contacts. In addition, the Department of the Air Force is the only service to have developed any guidance for its hospitals concerning herbicide related matters. We believe that the medical facilities in all services should receive appropriate guidance, including monitoring instructions for possible herbicide related cases.

RECOMMENDATIONS

We recommend that the Administrator of Veterans Affairs provide guidance to assure that

- in evaluating herbicide related claims, regional offices obtain all military record information pertaining to a veteran's possible exposure to herbicides in Vietnam and

- all veterans submitting such claims to VA regional offices are encouraged to contact VA health care facilities.

We also recommend that the Secretary of Defense provide guidance to ensure that Air Force, Army, and Navy medical facilities are uniformly monitoring and evaluating possible herbicide-related concerns of personnel who served in Vietnam. In addition, information developed through Defense medical facilities should be coordinated with VA.

AGENCY COMMENTS

VA agreed that regional offices should obtain all military record information concerning possible exposure to herbicides in Vietnam. It also agreed that veterans submitting claims of possible herbicide exposure should be encouraged to contact VA health care facilities.

Defense generally agreed with the recommendation to provide guidance to all DOD medical facilities.

CHAPTER 3

HEALTH EFFECTS STUDIES OF TCDD

The toxic effects of TCDD have been reported by investigators of chronic occupational exposure in the manufacture of chemicals contaminated by TCDD and acute exposure in industrial accidents. Also, many studies of the effects of TCDD have been conducted on animals. The long-range health effects on humans, however, remains largely unknown.

TOXIC EFFECTS OF TCDD IN HUMANS

In an August 1977 publication, 1/ the International Agency for Research on Cancer (IARC) of the World Health Organization noted that toxic effects in humans caused by TCDD have been reported after (1) occupational exposure during the industrial production of 2,4,5-trichlorophenol (the precursor of 2,4,5-T) and 2,4,5-T, (2) exposure during accidents at such facilities, and (3) exposure to herbicides and other materials containing TCDD. The exposed individuals developed a wide variety of dermatological, internal, neurological, and psychiatric disorders.

The dermatological disorders include:

--Chloracne which is probably the best known toxic effect of TCDD. Chloracne has been described by a medical authority 2/ as an eruption of blackheads, usually accompanied by small yellow cysts which, in all but the worst cases, are from pinhead to lentil size. 3/ Mild cases of chloracne reportedly clear within months, and after 3 years all but 20 percent of cases are likely to have resolved themselves. The most severe cases,

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1/"IARC Monographs On The Evaluation Of The Carcinogenic Risk Of Chemicals To Man," Vol. 15.

2/Dr. Kenneth Crow, "Chloracne: the chemical disease," New Scientist, Apr. 13, 1978, p. 78.

3/Lentil seeds are about 4 to 6 millimeters in diameter.

however, may still have active skin lesions 15 years after contact with the causative agent has ceased. Chloracne is considered a sign of potential systemic poisoning and an indication of exposure to TCDD or some other chloracnigen.

--Porphyria cutanea tarda which is characterized by photosensitivity, skin lesions, and hepatic (liver) dysfunction.

--Hyperpigmentation and hirsutism (abnormal hairiness).

The internal disorders include:

--Liver damage.

--Fat metabolism disorders.

--Carbohydrate metabolism disorders.

--Cardiovascular disorders.

--Urinary tract disorders.

--Respiratory disorders.

--Pancreatic disorders.

The neurological disorders include:

--Polyneuropathies which are diseases involving several nerves.

--Lower extremity weakness.

--Sensorial impairments (sight, hearing, smell, and taste).

The psychiatric disorders include:

--Neurasthenic or depressive syndromes; the neurasthenia was reported to be characterized by altered basic frame of mind, lack of drive and vigor, sleep disorders, emotional instability, such as a tendency to anger or irritability, and diminished libido or potency.

Defense evaluation of Herbicide Orange human health effects

In its 1978 report, 1/ the Air Force reviewed literature involving exposure to 2,4-D, 2,4,5-T, and TCDD. In summary it stated:

> "The pharmacodynamics and adverse effects of the phenoxy herbicides, trichlorophenol and TCDD were reviewed, primarily through reports of occupational exposure and accidents as well as reported exposures to the general public. A number of organ systems may be involved if the dose is significantly high with emphasis on the skin, liver, CNS and peripheral nervous system. Adverse effects of 2,4-D and 2,4,5-T should manifest themselves shortly after exposure. Symptoms arising for the first time months to years after the last exposure are probably due to an etiology other than 2,4-D and 2,4,5-T. The hallmark of TCDD is chloracne and its absence makes it unlikely that systemic disorders present are related to TCDD. Asthenic and vegetative symptoms are often present in overexposure but are difficult to interpret. They would normally be expected to clear with time. There is no conclusive evidence at this time that the phenoxy herbicides or TCDD are mutagenic, teratogenic or carcinogenic in man."

National Academy of Sciences study in South Vietnam

In a study of the ecological and physiological effects of the military use of herbicides in South Vietnam, NAS reported 2/ in 1974 that its study committee was unable to gather definitive indication of direct damage by herbicides to human health. NAS noted, however, that reports of Highlanders (Montagnards) on death and illness--abdominal pains, diarrhea, vomiting, respiratory symptoms, and rashes--caused by herbicides were so consistent that, despite the lack of medical and toxicological evidence for such effects they could not be dismissed and should be followed as promptly as

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1/"The Toxicology, Environmental Fate and Human Risk of Herbicide Orange and its Associated Dioxin." Oct. 1978.

2/"The Effects of Herbicides in South Vietnam."

possible by intensive studies which should include medical and behavioral sciences approaches. They recognized, however, that such studies would become possible only after peace had been restored in that area.

TOXIC EFFECTS OF TCDD IN ANIMALS

TCDD has produced a variety of toxic effects in laboratory animals. However, the results of studies on the mutagencity of TCDD have been conflicting and inconclusive. In addition, Air Force studies of mice gathered from an area previously sprayed with massive amounts of 2,4,5-T have indicated that although the mice accumulated TCDD in their livers, they apparently suffered no significant adverse health effects.

In its 1974 report, "The Effects of Herbicides in South Vietnam," NAS summarized the clinical signs of TCDD poisoning as follows:

> "* * * effects include necrotic 1/ changes of the liver; gastric hyperplasia 2/ or ulceration; hemorrhages in the gastrointestinal tract and various other organs; atrophy of the kidneys; and atrophy of the thymus and other lymphoid organs and tissues. * * * [These] changes appear to be the most commonly observed ones and may lead to reduced immunoresponses and thus a decrease in the animal's chemical defense mechanism. But whether any of the above changes are related to the primary toxic action of TCDD is not clear."

The authors did not specify whether these were acute or chronic effects.

The NAS also noted in its 1974 report that the teratogenicity 3/ of TCDD in mice is well established, although in rhesus monkeys no teratological effects had yet been found.

1/Pertaining to the death or decay of tissue.

2/The abnormal increase of normal cells in the stomach.

3/An agent or chemical is considered as teratogenic when it causes developmental disturbances in the embryo resulting in congenital malformations.

In its 1978 report, the Air Force stated:

"Subacute and chronic doses of TCDD produced a variety of toxic effects, including hepatic necrosis in mice, rats and rabbits; thymic atrophy in mice, rats and guinea pigs with adrenal gland hemorrhages and depletion of lymphoid organs also being seen in guinea pigs. Repeated oral doses of 0.001 to 10 µg/kg TCDD for four to 13 weeks did not significantly affect weight gain nor were signs of toxicity noted in mice and rats. Suppressed immune responses and changes in liver enzymes were noted, however, in mice. Repeated doses of TCDD as low as 1 µg/kg caused guinea pigs to become moribund and repeated doses of 0.04 µg/kg decreased lymphocyte counts. Rabbits developed acne of increasing severity when doses of 0.04 to 400 µg/kg were applied repeatedly to the internal surface of the ear. A total oral dose of 2-3 µg/kg over a nine month period produced severe hematological changes and death in rhesus monkeys."

EPA's 2,4,5-T working group concluded that there is sufficient evidence to indicate that 2,4,5-T, containing TCDD at levels as low as 0.05 parts per million, and TCDD alone can produce oncogenic 1/ effects in mamallian species (43 FR 17128, Apr. 21, 1978). The working group supported its conclusion with summaries of several studies. For example:

--A 95-week feeding study was conducted with male rats. Ten groups of 10 animals per group were fed ground food containing 0, 1, 5, 50, or 500 ppt TCDD, or 1, 5, 50, 500, or 1,000 parts per billion (ppb) TCDD. All rats receiving the three highest dose levels (50, 500, or 1,000 ppb TCDD) died between the 2d and 4th week of treatment. Tumors developed in 46 percent (23/50) of the rats ingesting 5, 50, or 500 ppt and 1 or 5 ppb TCDD compared to none in the control group or the group fed 1 ppt TCDD; carcinomas (cancerous growths) were observed in the ear duct, kidney, and liver. Also, neoplasms (any new or abnormal growth) were observed in 38 percent (23/60) of the six lowest dose groups compared with none in the control group.

1/Giving rise to tumors or causing tumor formation.

--In another study, female rhesus monkeys were fed diets containing 500 ppt TCDD for 9 months. Anemia, thrombocytopenia (decrease in the number of blood platelets), and leukopenia (reduction in the number of leukocytes 1/ in the blood) were the most debilitating changes. The altered lymphopoiesis (development of lymphatic tissue) could be associated with immune suppression. The authors reported widespread hypertrophy (enlargement or overgrowth of an organ), hyperplasia (abnormal increase in the number of normal cells in normal arrangement in a tissue), and metaplasia (abnormal change in the type of adult cells in a tissue) in the epithelium (the covering of internal and external surfaces of the body) of monkeys exposed to TCDD, and related this to data showing increased tumor frequency in TCDD-fed rats.

Potential mutagenicity of TCDD has not been determined

The mutagenicity of a pesticide is one of the hazards which EPA evaluates in determining whether a pesticide can be handled and used safely and whether the public is protected from injury. Although several studies have been conducted, the results have been conflicting and inconclusive.

Mutagenicity studies are designed to determine if a substance causes mutations. A mutation is any heritable change, such as a chemical transformation of an individual gene which may alter its functions, or a rearrangement of the structure of or a gain or loss of parts of a chromosome. Mutations may cause abortion, genetic disease, shorter life span, infertility, mental retardation, senility, and cancer.

EPA's 2,4,5-T working group concluded on the basis of a review of available studies "that there is a data gap on mutagenic effects and that further evidence and testing is needed on the mutagenicity of 2,4,5-T and TCDD."

A study entitled "A Review of the Genetic Toxicology of Chlorinated Dibenzo-p-Dioxins" sponsored in part by the National Institute of Environmental Health Sciences (NIEHS)

1/Small colorless cells which are important in the body's defense against infection.

reached the same conclusion as EPA's 2,4,5-T working group. The February 1978 study report stated that:

> "Data available for assessing the mutagenic potential of TCDD are conflicting and scarce. Differences in testing results reported in these studies could be attributed to solubility problems with the test chemical, treatment protocols, purity of test samples, or toxicity. Because there are conflicting data, additional experiments are needed before the mutagenic potential of TCDD and other dioxins can be determined. Studies exploring the promoting effect of dioxins on the mutagenicity of other compounds are also recommended because experiments have shown TCDD to be an extremely active liver enzyme inducing agent that enhances the mutagenicity of certain polycyclic hydrocarbons such as 3-methylcholanthrene in vitro."

Air Force study at Eglin Air Force Base Reservation in Florida

From 1962 to 1970 the Air Force sprayed 346,117 pounds of herbicides (including 160,948 pounds of 2,4,5-T) on a 1 square mile test area at the Eglin Air Force Base Reservation to test aerial spray equipment. Subsequently, the Department of Chemistry and Biological Sciences, U.S. Air Force Academy, initiated studies on Herbicide Orange and TCDD in 1972 to (1) investigate soil incorporation/biodegradation as a disposal method for Herbicide Orange, (2) investigate the ecological effects associated with past uses of Herbicide Orange, and (3) investigate the soil persistence and food chain accumulation of TCDD.

In an October 1978 presentation to the American Society for Testing Materials, Air Force officials reported on the results of field investigations at the Eglin Air Force Base test area. They reported no evidence that the herbicides produced any adverse, long-term health effects in the field species examined. Specifically, they reported that:

> "Gross pathology was done on all species collected for TCDD residue analyses. Histopathological 1/

1/Pertaining to the study of changes in tissues caused by disease.

examinations were performed on over 300 beachmice or hispid cotton rats from the test area and a control field site. Examinations were performed on the heart, lungs, trachea, salivary glands, thymus, liver, kidneys, stomach, pancreas, adrenals, large and small intestine, spleen, genital organs, bone, bone marrow, skin and brain. Initially, the tissues were examined on a random basis without the knowledge of whether the animal was from a control or test area. All microscopic changes were recorded including those interpreted as minor or insignificant. The tissues were then reexamined on a control and test basis, which demonstrated that the test and control mice could not be distinguished histopathologically. Similar histopathological studies were conducted on the fish and racerunner, and again no significant abnormalities were found."

LONG-RANGE HEALTH EFFECTS OF TCDD ON HUMANS HAVE NOT BEEN DETERMINED

Although TCDD is one of the most toxic compounds known, the long-term human health effects of TCDD exposure are virtually unknown.

IARC concluded in its 1977 publication (see p. 17) that insufficient data is available to evaluate the carcinogenicity of 2,4,5-T and TCDD to man. IARC stated, with respect to TCDD:

"A number of cases of cancer have been reported in workers exposed to TCDD, but no adequate epidemiological studies were available. An increased proportion of liver cancers has been reported in Hanoi, after the spraying of herbicides (2,4-D and 2,4,5-T) containing TCDD in South Vietnam. The significance of these observations cannot be assessed because not enough details were reported. More details of the reported cases and more extensive observation of the exposed people are needed before an evaluation of the carcinogenicity of chlorinated dibenzodioxins to man can be made."

The authors of the NIEHS-sponsored study (see p. 22) observed that the importance of understanding the hazards to human health from dioxin compounds, including TCDD, and

the insufficient data available to properly evaluate their long-term health risks have generated several research projects.

In January 1978 a joint NIEHS/IARC ad hoc working group was convened to consider the feasibility of coordinating epidemiological studies on the long-term health hazards associated with dioxin compounds and certain other structurally related compounds. The working group noted in a June 1978 report 1/ that a need had become clear for (1) better coordination of ongoing and projected epidemiological efforts and (2) a worldwide action plan for harmonizing the various activities already in progress or in preparatory stages.

The NIEHS/IARC working group included in its report comments and recommendations concerning followup of accident-exposed individuals in five countries. The working group also recommended

--Development of a system for an international exchange of information and research coordination on the health effects of dioxins and other structurally related compounds.

--Development of common protocols (plans) for clinical examinations and, in particular, design of a protocol for basic core information.

--Development of an international registry of exposed persons to serve as a basis for long-term followup. This was considered especially important because the relatively small size populations involved in individual exposure episodes are an obstacle to risk assessment. Therefore, pooling of data is almost a necessity.

In its 1978 report, the Air Force stated that "The long-term effects of large acute doses of TCDD or small intermittent or chronic exposures are not known."

1/"Long-Term Hazards of Polychlorinated Dibenzodioxins and Polychlorinated Dibenzofurans"

Need for study of health risks to herbicide-exposed personnel in South Vietnam

Because of (1) the very high toxicity of dioxin to animals, (2) the presence of this substance in Herbicide Orange, (3) preliminary reports of TCDD in fish in Vietnam, and (4) the lack of data permitting assessment of TCDD effects on humans, NAS recommended in its 1974 report on "The Effects of Herbicides in South Vietnam" that long-term studies be made for assessing the potential harmful effects of TCDD on man. Among other specific recommendations, NAS strongly urged a comprehensive medical study of the approximately 50 Vietnamese military personnel who were heavily exposed as handlers of herbicides in the defoliation program, if they could be located, as compared with an appropriate "control" group. The authors noted that this group of personnel, which was identified near the end of the studies in South Vietnam, had been handling herbicides--transferring them from the containers in which they arrived, to other containers and to the aircraft--for many years and therefore appeared to represent a population uniquely suited for studies of any long-term medical effects.

We believe that the proposed study of the Vietnamese herbicide handlers could have provided important data on the potential long-term medical effects on personnel exposed to Herbicide Orange. Since such a study could not be done because of U.S. withdrawal from Vietnam, however, we believe a survey of military personnel identified as most likely to have been exposed to herbicides, might also provide data on any long-term medical effects. This survey could be performed by trying to locate those personnel most likely to have been exposed to herbicides and taking a medical history of these individuals since the time of exposure in an effort to ascertain whether this history reveals evidence of disease that could be related to herbicide exposure. Such a survey is needed because:

--Data is lacking on any long-term medical effects of Herbicide Orange and TCDD. Without such information, VA action to deal with concern over herbicide exposure is handicapped.

--The survey could provide data related to the effects of exposure to Herbicide Orange and other chemicals as used in South Vietnam. Any data developed by investigations of 2,4,5-T as currently manufactured and used in the United States would not necessarily be applicable to the use of Herbicide Orange in South Vietnam because of differences in the contaminant levels.

--The continuing public and veterans' concerns over the alleged health risks attributed to herbicides need to be resolved.

As noted on page 7, Defense has identified about 500 aircraft crew members involved in herbicide spraying missions. If it is determined that these crew members were the personnel most likely to have been exposed to herbicides they could serve as the nucleus of a systematic followup survey. We believe that Defense should conduct such a survey with the assistance and guidance of an interagency group composed of knowledgeable representatives from interested agencies, such as Department of Health, Education, and Welfare; VA; and EPA. An effective interagency group could provide the expertise needed to help insure that the survey is properly planned and carried out and could serve to minimize possible criticism of the findings and conclusions.

RECOMMENDATION TO THE SECRETARY OF DEFENSE

The Department of Defense, with the assistance and guidance of an appropriate interagency group, should conduct a survey of any long-term medical effects on military personnel who were likely to have been exposed to herbicides in South Vietnam.

Agency Comments and Our Evaluation

Defense doubted that a retrospective epidemiological study would produce reliable results because (1) 17 years had elapsed from the beginning of herbicide operations in Vietnam, during which time any number of other influences on health could have taken place, (2) generally, there is no data on exposure concentrations and times, and (3) identifying an appropriate control group would be virtually impossible. Defense said, however, that a study of an

appropriate group would be valuable to determine the long-term health effects of TCDD. In this regard, it pointed out that it was supporting an NAS study being developed to assist in determining the health effects of the release of large amounts of TCDD into the environment from an industrial accident in Seveso, Italy.

We agree that there would be limitations on a study of Vietnam veterans and that the Seveso accident might provide more scientifically valid study results. However, we believe that it would be desirable to obtain information specifically related to the herbicides as used in Vietnam because the results of the Seveso study may not be entirely applicable to Vietnam. For example, scientists told us that the toxicological effects of the same chemical may vary due to (1) environmental/climatic differences, (2) differences in the degree and duration of exposure, and (3) interaction with other chemicals.

Although a study of Vietnam may have limitations in terms of scientifically associating specific health effects with individual chemicals, it could provide information on the general health of those most likely to have been affected by herbicides. This, in turn, would help provide an indication of general problems, if any, that may be related to the herbicides as used in Vietnam. We believe that this information would be valuable to VA and others concerned with determining if there is a basic health problem among personnel who served in Vietnam.

THE MILITARY USE OF HERBICIDES IN SOUTH VIETNAM 1/

Military herbicide operations began in South Vietnam in early 1962 and were phased out in 1971. After a relatively slow buildup from 1962 to 1965, the operations increased rapidly to a peak in 1967; declined, but only slightly, in 1968 and 1969; and dropped sharply in 1970. According to information from Defense, the last herbicide spraying by fixed-wing aircraft occurred on January 7, 1971. After this, herbicide operations were limited to spraying around fire base perimeters, on enemy cache sites, and along land and water communication routes; all were carried out by helicopter or on the ground. The last helicopter spraying operation under U.S. control was flown on October 31, 1971.

THE HERBICIDAL AGENTS USED

The herbicidal agents used in South Vietnam were identified by code names that referred to the color of bands painted on the containers of the chemicals: Orange, White, Blue, and Purple.

Agent Orange is a 50:50 mixture of the n-butyl esters of 2,4-D ([2,4-dichlorophenoxy] acetic acid) and 2,4,5-T ([2,4,5-trichlorophenoxy] acetic acid). Each gallon of Orange contains 4 pounds of 2,4-D and 4.6 pounds of 2,4,5-T on an acid equivalent basis. 2/ Agent Orange was used most extensively in Vietnam until its use was terminated on April 15, 1970, because of concerns of its possible teratogenicity and its contamination with the highly toxic TCDD.

1/Information excerpted from "The Effects of Herbicides in South Vietnam," NAS, Feb. 1974.

2/Acid equivalent is the weight of the acid form of the chemical. This is used because the weights of various ester or amine formulations vary. Expression in terms of acid equivalents provides a uniform basis for comparison of different formulations.

Agent Purple is a 50:30:20 mixture of the n-butyl ester of 2,4-D, and n-butyl and isobutyl esters of 2,4,5-T. It was used only until 1964 and was then replaced by Agent Orange.

Agent White is a mixture containing 2 pounds of 2,4-D and 0.54 pounds of picloram (4-amino-3,5,6-trichloropicolinic acid) per gallon on an acid-equivalent basis. It is a formulated product containing 2,4-D and picloram as the triisopropanolamine salts, with the addition of surfactants and water.

Agent Blue is formulated as the sodium salt of cacodylic acid (hydroxydimethylarsine oxide). It contains a minimum of 21-percent sodium cacodylate with additional free cacodylic acid for a total dimethylarsinic acid equivalent of not less than 26 percent on a weight basis, or 3.1 pounds of cacodylic acid and about 1.7 pounds of arsenic per gallon with 5-percent surfactant and 0.5-percent antifoam agent.

All agents were for use at a rate of 3 gallons per acre (28 liters per hectare), except that in the earlier operations and on rare occasions thereafter only half of this dose was used. The herbicides were applied by fixed-wing aircraft (UC-123), helicopter (UH-1), from trucks, from riverboats, and from backpacks. Aircraft were outfitted with special spraying equipment consisting essentially of a container and a spray boom with nozzles. The container of the plane spray system had a 1,000-gallon capacity and normally flew at 150 feet with a delivery speed of 130 to 140 knots. The spray-on time of 3-1/2 to 4 minutes permitted approximately 950 gallons of herbicide to be distributed at the rate of 3 gallons per acre. The capacity of the helicopter spray system container was 200 gallons, but the helicopter could carry only 100 gallons because of weight limitations. Herbicide spraying from tanker trucks used 50-gallon or 100-gallon drums. Spraying by riverboats was done directly from the agents original 55-gallon drums; backpack sprayers had 3-gallon drums. The great majority of the herbicides were sprayed by plane--at least into the later part of 1970, from which time helicopter herbicide operations increased and gradually became the only aerial means of herbicide delivery.

APPENDIX II

APPLICATION OF HERBICIDES IN THE VIETNAM WAR (note a)

Agent	1962 to July 1965 (note b)	Aug-Dec. 1965	1966	1967	1968	1969	1970	1971	Total
		(millions of gallons)							
Orange	-	0.37	1.64	3.17	2.22	3.25	0.57	-	11.22
White	-	-	0.53	1.33	2.13	1.02	0.22	0.01	5.24
Blue	-	-	0.02	0.38	0.28	0.26	0.18	-	1.12
TOTAL	1.27	0.37	2.19	4.88	4.63	4.53	0.97	0.01	18.85

b/Detail by type of herbicide not available

HERBICIDES USED IN SOUTH VIETNAM 1965 TO 1971

Agent	Active chemical components	Military application rate (lb./acre)	Millions of gallons used, Aug. 1965 to 1971
Orange	2,4-D	12.00	11.22
	2,4,5-T	13.80	
White	2,4-D	6.00	
	Picloram	1.62	5.24
Blue	Cacodylic acid	9.30	1.12
TOTAL			17.58

Source: "The Effects of Herbicides in South Vietnam," NAS, Feb. 1974.

a/Defense statistics on herbicide use shown on p. 2 and NAS statistics on herbicide use differ because Defense used procurement records only while NAS used procurement records and estimates.

APPENDIX III

ASSISTANT SECRETARY OF DEFENSE
WASHINGTON, D. C. 20301

MANPOWER,
RESERVE AFFAIRS
AND LOGISTICS

8 FEB 1979

Mr. Henry Eschwege
Director, Community and Economic
Development Division
U. S. General Accounting Office (GAO)
Washington, D. C. 20548

Dear Mr. Eschwege:

This is in response to your letter of November 22, 1978, to the Secretary of Defense concerning a draft GAO proposed report entitled "Need to Determine Long-Term Health Effects of Exposure to the Herbicide Agent Orange in South Vietnam" (OSD Case #4992A) (Code 08766).

The report is generally well written and comprehensive. We do recommend, however, that the enclosed comments be considered for accuracy and completeness.

There also is a lack of recognition and inadequate attention to the very comprehensive Air Force report published in October 1978, OEHL TR-78-92, "The Toxicology, Environmental Fate and Human Risk of Herbicide Orange and its Associated Dioxin." This report was provided to the Subcommittee on Medical Facilities and Benefits of the Veterans Affairs Committee of the House of Representatives on October 11, 1978. The report supports the Department of Defense (DoD) position presented in testimony that there is little or no relationship between many alleged symptoms and past exposure to herbicide orange in Vietnam.

We agree with the recommendation that the Secretary of Defense provide guidance to ensure that all DoD medical facilities are aware of possible herbicide orange health effects. We do not agree, however, with the recommendation that the DoD undertake a comprehensive interagency study of the long-term medical effects on military personnel who might have been exposed to herbicide orange in Vietnam. It is extremely doubtful that a retrospective epidemiological study of that population would produce reliable results because:

- Approximately 17 years have elapsed since the beginning of herbicide operations in Vietnam. During this interim, any number of other

influences on health may have supervened. Thus, it would be virtually impossible to assure that the results of the study were not confounded by variables other than the variable of interest, viz., herbicide orange exposure,

- There are, generally, no data on exposure concentrations and exposure times. Lacking a reliable estimate of exposure, the interpretation of the results would be highly unreliable, and

- Identifying an appropriate control group would be virtually impossible. For any group to serve as appropriate control, it would be necessary to show that these people were not exposed to herbicide orange, and that they have, essentially, the same shared influences on their health as those of the exposed group.

The DoD believes, however, that an epidemiological study of an appropriate group would be valuable to determine the long-term human health effects of TCDD (dioxin). Ideally such a study would require a population with known exposure conditions and a similar unexposed cohort for controls. We are, therefore, supporting the current effort of the National Academy of Science's Committee of Toxicology to develop a study team, comprised of knowledgeable technical personnel from all areas, to perform a cooperative study with the Italian government and universities to assess the health effects of the release of large amounts of TCDD into the environment from an industrial accident in Seveso, Italy. This will provide a comprehensive, real-time epidemiological study where known concentrations of TCDD were measured, known exposures are documented and prompt medical follow-up has been performed. It will provide a far better analysis of the effects of TCDD on humans (and animals) than the sort of retrospective study proposed in the GAO report.

Sincerely,

Richard Danzig

Richard Danzig
Acting Principal Deputy Assistant
Secretary of Defense (MRA&L)

Enclosure

GAO note: The enclosure to this letter was considered in the preparation of our final report but has not been included.

VETERANS ADMINISTRATION
OFFICE OF THE ADMINISTRATOR OF VETERANS AFFAIRS
WASHINGTON, D.C. 20420
JANUARY 25 1979

Mr. Gregory J. Ahart
Director, Human Resources Division
U. S. General Accounting Office
441 G Street, NW
Washington, DC 20548

Dear Mr. Ahart:

We have reviewed the November 24, 1978 draft report, "Need to Determine Long-Term Health Effects of Exposure to the Herbicide Agent Orange in South Vietnam," which discusses the military herbicide operations in South Vietnam and Agent Orange, the most widely used herbicide. A component of Agent Orange contains a highly toxic contaminant, TCDD (Dioxin). Its use has caused great public concern.

The report states the VA actions have been hampered by lack of information on the long-term health effects of herbicides, and VA is having difficulties identifying veterans who were exposed to herbicides in Vietnam.

We offer our comments on the report and the recommendations

[See GAO note 1, p. 36.]

(2) that veterans submitting claims to VA Regional Offices are encouraged to contact VA health care facilities, and (3) that regional offices obtain all military record information pertaining to a veteran's possible exposure to herbicides in Vietnam.

The VA concurs in the recommendation that regional offices obtain all military record information pertaining to a veteran's possible exposure to herbicides in Vietnam.

[See GAO note 1, p. 36.]

APPENDIX IV

Mr. Gregory J. Ahart
Director, Human Resources Division

This Agency is attempting to obtain valid information on the long-term health effects of herbicides by examining all Vietnam veterans who claim exposure to herbicides and, with the aid of a central herbicide registry, follow them over a prolonged period of time. This effort should clarify many of the current uncertainties regarding the adverse health effect of herbicides.

We concur in the recommendation that veterans submitting claims of possible herbicidal exposure be encouraged to contact VA health care facilities. Instructions to VA facilities are being revised to clarify the VA's policy of examining all veterans for toxicity if possible herbicidal exposure is indicated. This policy applies to all veterans whether or not they claim to have signs and symptoms resulting from such exposure.

The study mentioned on page 11 of the report is a pilot study which will attempt to detect dioxin in human body fat. Ten veterans who were actual handlers of herbicides in Vietnam and therefore extensively exposed, will be studied to determine whether or not any unusual concentration of dioxin is found in the fat tissues of those exposed to herbicides as compared to 10 controls. If no differences are found between the two groups, the determination of dioxin levels in body fat will not be used as a diagnostic test.

[See GAO note 1, p. 36.]

Mr. Gregory J. Ahart
Director, Human Resources Division

/See GAO note 1 below./

Thank you for the opportunity to review this draft report.

Sincerely,

MAX CLELAND
Administrator

GAO notes:

1. Deleted material pertained to a matter contained in the draft report which has been changed or is not included in this report.

2. Page references in this appendix refer to our draft report and do not necessarily agree with this final report.

APPENDIX V

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

22 MAR 1979

OFFICE OF
PLANNING AND MANAGEMENT

Honorable Henry Eschwege
Director, Community and Economic Development
Division
United States General Accounting Office
Washington, D.C. 20548

Dear Mr. Eschwege:

The Environmental Protection Agency (EPA) has reviewed the General Accounting Office (GAO) proposed report entitled "Need to Determine Long-Term Health Effects of Exposure to the Herbicide Agent Orange in South Vietnam."

GAO makes a number of recommendations concerning the identification of veterans with adverse health effects resulting from exposure to herbicides in South Vietnam, and the evaluation of herbicide-related compensation claims received by the Veterans Administration (VA). GAO also recommends that the Department of Defense, with the assistance and guidance of an interagency group which would include EPA, conduct a comprehensive study of any long-term medical effects on military personnel who were likely to have been exposed to Agent Orange in South Vietnam, as compared with an appropriate control group. It is the latter recommendation, which entails EPA's participation, that I would like to address.

On March 1, 1979, Deputy Administrator Barbara Blum announced the emergency suspension of and the Agency's intention to cancel 2,4,5-T (a component of Agent Orange) for use in forests and on pastures and rights-of-way. The intensive review of the risks and benefits of 2,4,5-T initiated in April 1978 continues for uses not affected by the suspension such as rice paddies and rangeland uses.

APPENDIX V

Agent Orange per se was never registered or used in the United States, though its components and other similar herbicides were.

However, the use pattern of Agent Orange in Vietnam differed from the use authorized for its component herbicides in the United States. Further, the level of dioxin contamination in Agent Orange was much higher than the levels of dioxin found in domestically registered phenoxy herbicides. Therefore, we are not sure how meaningful the proposed study would be to our rebuttable presumption against registration (RPAR) review, for rice and rangeland, or to consideration of the risks and benefits of 2,4,5-T, during the cancellation proceedings. We would, of course, welcome all possible data on human health effects of Agent Orange and would attempt to draw whatever conclusions are scientifically possible from the Vietnam experience.

We see the best potential for the study as being a possible source of valuable information for the treatment of veterans potentially affected by use of Agent Orange and evaluation of VA claims possibly resulting from herbicide exposure. EPA already participates in an existing interagency advisory group to assist in evaluating the medical aspects of veterans' exposure to herbicides, and will afford the VA scientific and technical support through that group should the recommended study be undertaken.

We appreciate the opportunity to comment on this report prior to its issuance to Congress.

Sincerely yours,

C. William Carter

for William Drayton, Jr.
Assistant Administrator
for Planning and Management

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