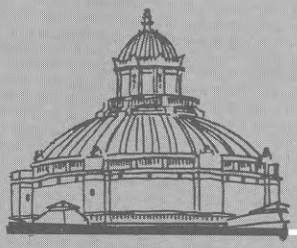
Issue Brief



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AGENT ORANGE: VETERANS' COMPLAINTS CONCERNING EXPOSURE TO HERBICIDES IN SOUTH VIETNAM

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ISSUE DEFINITION

The United States Air Force (USAF) sprayed various herbicide mixtures (chemicals that kill plants) for military purposes in South Vietnam from 1962 to 1971 to defoliate jungle growth to deprive the Communist forces of ground cover and to destroy enemy crops to restrict food supplies. One herbicide component known as 2,4,5-T (2,4,5-trichlorophenoxyacetic acid -- which is perhaps best known as a component of the herbicide mixture called "Agent Orange") was contaminated with a chemical known as TCDD (tetrachlorodibenzo-para-dioxin, or simply "dioxin"). According to Gosselin, et al., Clinical Toxicology of Commercial Products, TCDD is classified as class 6, super toxic, in a range of 1 (practically non-toxic) to 6: "TCDD may be the most toxic and potent teratogen known to man based on toxicological data in guinea pigs and rabbits." [CRS has been unable to locate any report of a human death from exposure to pure TCDD.] The probable lethal dose for humans would be less than 5 mg/kg, which for a 150 lb. (70 kg) person is equal to a taste (less than 7 drops). TCDD may also be carcinogenic (cause cancer), teratogenic (cause birth defects while the mother is pregnant), or mutagenic (cause mutations in the parents' germ cells that may later result in birth defects in the offspring). There is evidence of non-lethal human health effects following exposure to small amounts of TCDD as a contaminant in other compounds such as a skin condition known as chloracne and a liver condition known as porphyria cutanae tarda. Several animal studies using TCDD have demonstrated positive test results for carcinogenicity, teratogenicity, and mutagenicity.

Congressional interest was triggered by receipt of reports from Vietnam veterans who believe they have been harmed by exposure to herbicides, particularly the mixture of 2,4-D and 2,4,5-T known as Agent Orange. The 96th Congress held numerous hearings on the use of herbicides in South Vietnam, and various initiatives to deal with the problem were introduced. P.L. 96-151 was enacted to direct the Veterans' Administration to conduct an epidemiological study on Vietnam veterans to determine whether there may be adverse human health effects associated with dioxin exposure. This study and other studies planned will help elicit answers to the scientific questions posed by the Veterans' Administration in determining whether or not the veterans' medical problems, allegedly due to exposure to "Agent Orange" and associated herbicides used in Vietnam, are compensable. Following recommendations made by the Interagency Workgroup on Phenoxy Herbicides, the 97th Congress plans to consider legislation that would expand the scope of the Veterans Administration study of health effects of Agent Orange to include other factors related to military service in Vietnam. The Congress will also consider legislation to require the VA to begin studying ways to resolve veterans' disability claims based on dioxin exposure.

BACKGROUND AND POLICY ANALYSIS

History

During the summer of 1969, the first reports of human birth defects allegedly attributed to Agent Orange appeared in Vietnamese newspapers. Based on these allegations and the results of a study sponsored by the National Cancer Institute that showed that 2,4,5-T contaminated with TCDD caused birth defects in laboratory animals, the USAF stopped spraying 2,4,5-T

in South Vietnam in April 1970.

Although the Department of Defense maintains that only a limited number U.S. military personnel can be positively identified as having been exposed to 2,4,5-T in South Vietnam (i.e., crews of aircraft that were used to spray herbicides), it is theoretically possible that large numbers of both military personnel (from the United States, South Vietnam, North Vietnam and Australia) and civilians (especially South Vietnamese peasants) were exposed to 2,4,5-T through the USAF spraying program. A growing number of U.S. veterans who served in South Vietnam have begun to attribute the cause of various chronic ailments which they are now experiencing (especially nervous disorders, cancers, and birth defects) to exposure to 2,4,5-T in South Vietnam, and many have filed claims with the VA for compensation. The VA has not yet awarded compensation to veterans for any claims related to 2,4,5-T exposure due to the following two reasons: the lack of valid human data to prove a cause and effect relationship between exposure to 2,4,5-T and/or TCDD and specific health effects (except for chloracne); and the difficulty of determining which veterans have and have not been exposed to 2,4,5-T.

TCDD Contamination

The industrial production of 2,4,5-T always results in some TCDD contamination although TCDD levels can be reduced to about 0.01 parts per million (ppm) with current technology. Because it was not widely recognized until the late 1960s that 2,4,5-T could contain hazardous amounts of TCDD, manufacturers did not start reducing the level of TCDD in 2,4,5-T until the USAF was already winding down its herbicide spraying program. The average TCDD levels in the 2,4,5-T - containing herbicide mixtures used in South Vietnam were approximately 2 ppm in Agent Orange (which accounted for approximately 96% of the 2,4,5-T used in South Vietnam), approximately 32.5 ppm in Agent Purple, and 65.6 ppm in Agents Pink and Green (Agents Purple, Pink, and Green contained the remaining 2,4,5-T used in South Vietnam). [The herbicides procured by the USAF were code named after the colored band that was placed around each 55 gallon drum in order to identify the contents.]

Health Effects — Animal Data

Although TCDD is well established as one of the most toxic chemicals known (surpassed only by the botulinum toxin and certain chemical warfare agents for acute (short-term) effects, there is no consensus in the scientific community over the chronic (long-term) effects on humans of exposure to low levels of TCDD (such as those levels found in the herbicides used in South Vietnam).

Statistically significant animal experiments have demonstrated that 2,4,5-T containing low levels of TCDD and/or TCDD alone have caused various tumors in mice and rats. A recently released National Toxicology Program bioassay of TCDD confirms these earlier reports that TCDD is carcinogenic in laboratory animals. Birth defects (such as cleft palate, kidney anomalies, skeletal and intestinal tract anomalies, and depressed fetal weight) and death in baby mice, rats, hamsters, and birds when the mothers were exposed during pregnancy have also been reported. A National Toxicology Program animal study of male reproductive effects of exposure to TCDD, however, has failed to reveal a statistically significant increase in reproductive abnormalities in TCDD exposed animals and birth defects in the TCDD-exposed male animals' offspring.

Statistically significant results of animal experiments have also demonstrated that exposure to TCDD can suppress cell mediated immunity (thus making an animal less resistant to infections) and can cause liver damage. Experiments using small numbers of monkeys (too limited to be statistically valid) exposed to low levels of TCDD in their diets have shown both reproductive problems (menstrual irregularities, poor conception, and fetal wastage) and death (within nine months) from severe hematological alterations.

Although there is some experimental evidence that TCDD may cause mutations (changes in the cell's genetic material that may produce birth defects in as-yet-unconceived offspring), these experiments have been few, they have been done mainly on non-mammalian species or in vitro (in test tubes), and they have basically been inconclusive.

Health Effects -- Human Data

If a cause and effect relationship is to be scientifically established between human exposure to a chemical and chronic health effects, a study which meets the following minimum criteria must be conducted to prove that such a relationship exists: a group of people (the "study group") must be identified that has already been exposed to the chemical under study (it would help to know the level of exposure); this study group must be large enough to detect chronic effects with statistical significance (to find an effect that occurred in 1 out of 100 people, one would need to examine at least 100 people); a control group must be found that ideally would differ from the study group only by never having been exposed to the chemical under study (thus, any differences in chronic health effects between the study and control groups could be attributed only to exposure to the chemical under study); and, due to the long latency period for many chronic effects, the study and control groups must be followed for as many years after exposure as it takes for the chronic effects to show up (i.e., in carcinogenicity studies, subjects must be followed for a minimum of 10 to 20 years after exposure to the suspect carcinogen). Cause and effect relationships which have been proven for human exposure to TCDD and/or 2,4,5-T contaminated with TCDD have been for chloracne and porphyria cutanae tarda, although there is some inconclusive but suggestive human and validated animal evidence that other maladies may result. (See Tables I and II)

Workers who have been exposed to TCDD and/or 2,4,5-T in industrial accidents (and to a lesser extent, family members who have come in contact with the worker's clothes) are frequently found to have a skin condition known as chloracne -- which resembles normal acne except that it is caused by chemical exposure. Chloracne can appear from weeks to months after initial exposure and while mild cases (blackheads) may clear in a matter of months, severe cases (inflammatory lesions and scars) may last up to 15 years after exposure has ceased. While the severity of chloracne is not thought to correlate precisely with the intensity or duration of exposure to TCDD and/or 2,4,5-T, chloracne is associated so closely with exposure that some scientists argue that patients who have not exhibited chloracne are unlikely to have suffered other toxic effects of TCDD and/or 2,4,5-T exposure.

Workers who have been exposed to TCDD and/or 2,4,5-T in industrial accidents have reportedly experienced certain health problems. Although no reports clearly indicate a correlation between TCDD/or contaminated 2,4,5-T chronic health effects, there are data which appear to support the need for

continued study. For example, according to the United States Air F Technical Report on the Toxicology, Environmental Fate, and Human Risk Herbicide Orange and its Associated Dioxin (1978), the following symptoms signs, or disorders (described in Table I) have been reported after occupational exposure to TCP (2,4,5-T's precursor), 2,4,5-T, or TCDD (see Table I at end of BACKGROUND section). As noted these studies, which reported symptoms associated with human exposure to dioxin, were not conducted in such a way as to prove a cause-and-effect relationship between exposure to TCDD and/or 2,4,5-T and any of these effects, but they may be indicative of such a relationship.

The following data illustrate studies of cancers found in humans exposed to dioxins. (Table II) These studies do not show a clear cause/effect relationship between carcinogenicity associated with exposure to TCDD and/or 2,4,5-T because very few exposed workers (with the exception of those in Nitro, West Virginia) have been followed for more than ten years (the latency period for most cancers being 15 to 40 years after exposure) and the results have been equivocal. However, they support a continuing suspicion and indicate a need for further study. The scientific panel of the Interagency Work Group on Phenoxy Herbicides recently reported on its review of five research papers by European scientists (* papers in Table II). The panel concluded that despite the studies' limitations, they do "show a correlation between exposure to phenoxy acid herbicides and an increased risk of some forms of cancer."

TABLE II

CANCERS BY SITE REPORTED IN STUDIES OF WORKERS EXPOSED TO PHENOXYACETIC ACIDS AND THEIR CONTAMINANTS

REFERENCE	STUDY	RESULTS
Causes of Death Among Lumberjacks—A Pilot Study. Christer Edling, M.D. (not published).	Death causes among 375 union-affiliated male lumberjacks throughout Sweden were studied.	Fewer cancer deaths than expected using Standard Mortality Ratios. When case-referent type of analysis (based on occurred deaths, not expected deaths), was used there was an excess of kidney cancer and hematopoietic cancer.
Symptomatology, morbidity and mortality experience of chlorinated phenoxyacid herbicide (2,4-D, 2,4,5-T) sprayers in Finland. A clinical and epidemiological study. V. Riihimaki, S. Asp, A.M. Seppalainen and S. Hernberg Working Paper for International Agency for Research on Cancer Working Group meeting on "Coordination of Epidemiological Studies on the Long-term Hazards of Chlorinated Dibenzodioxins and Chlorinated Dibenzofurans." Lyon, France, January 10-11, 1978.	A retrospective and prospective mortality study of 2,4-D and 2,4,5-T sprayers.	Fewer cancers than expected: workers examined had total length of exposure of only a few weeks.

TABLE II (cont.)

CANCERS BY SITE REPORTED IN STUDIES OF WORKERS EXPOSED TO PHENOXYACETIC ACIDS AND THEIR CONTAMINANTS

REFERENCE	STUDY	RESULTS
A Mortality Analysis of Employees Engaged in the Manufacture of 2,4,5-Trichlorophenoxy-acetic Acid and Trichlorophenol M.G. Ott, B.B. Holder, R.D. Olsen Journal of Occupational Medicine, vol. 22, no. 1, January 1980.	Mortality study of 204 persons exposed to 2,4,5-T and TCP during its manufacture. Length of exposure: range from less than 1 year to 10 years.	No adverse mortality effects.
The Mortality Experience of Workers Exposed to TCDD in a Trichlorophenol Process Accident. Judith A. Zack and Raymond R. Suskind Journal of Occupational Medicine, vol. 22, no. 1, January 1980.	121 workers who developed chloracne after an accident at Nitro, West Virginia in 1949 were followed for 30 years.	No apparent excess in total mortality or in deaths from malignant neoplasms or diseases of the circulatory system.
A Mortality Study of Workers Employed at the Monsanto Company Plant in Nitro, West Virginia Judith A. Zack Aug. 14, 1980	Mortality study of 885 male Nitro plant workers who were assigned to an area of TCT or 2,4,5-T production.	Bladder cancer is the only statistically significant neoplasm exported. Lung cancer mortality appears to be elevated.
*Mortality Study of Persons exposed to Dioxin Following an Accident which occurred in the BASF on November 13, 1953	Mortality study of 75 people who were exposed to trichloro-phenol-dioxin during an accident.	Six malignant neoplasms found, 3 expected: highest number in the gastrointestinal tract where 4 cancers were observed and 1 or 2 were expected. Mortality rates fluctuated depending on the comparison.

Alfred M. Thiess and
R. Frentzel-Beyme
Presented at the Fifth
International
Conference of
Medi-Chem--Ocupational
Medicine and Health
Protection, San
Francisco, September
1977.

TABLE II (cont.)

CANCERS BY SITE REPORTED IN STUDIES OF WORKERS EXPOSED TO PHENOXYACETIC ACIDS AND THEIR CONTAMINANTS

REFERENCE	STUDY	RESULTS
*Case Control Study: Soft Tissue Sarcomas and Exposure to Phenoxyacetic Acids or Chlorophenols. I. Hardell and A. Sandstrom. British Journal of Cancer (1979) 39, 711.	A matched case-control study of patients with soft-tissue sarcomas and previous exposure to phenoxy-acetic acids and chlorophenols.	Approximately a 6-fold increase in risk of soft-tissue sarcomas.
*Herbicide Exposure and Tumor Mortality: An Updated Epidemiological Investigation on Swedish Railroad Workers. Olav Axelson, Lennart Sundell, et al. Scandinavian Journal of Work and Environmental Health (in press).	Updated analysis of 348 railroad workers who were exposed to herbicides phenoxy acids and amitrol	Number of tumor deaths is higher than expected, especially among those with early exposure to both amitrol and phenoxy acids. The update demonstrated a more pronounced tumor mortality among people exposed to phenoxy acids. No specific type of tumor dominates, although there are three stomach cancers and three lung cancers.

TABLE II (cont.)

CANCERS BY SITE REPORTED IN STUDIES OF WORKERS EXPOSED TO PHENOXYACETIC ACIDS AND THEIR CONTAMINANTS

REFERENCE	STUDY	RESULTS
*Case-Control Study on Malignant Mesenchymal Tumors of the Soft Parts and Exposure to Chemical Substances. M. Eriksson, N. Berg, L. Hardell, O. Axelson, et al. Lakartidningen 76: 3872-75, 1979.	One hundred and ten tests and 219 controls who suffered from mesenchymal tumors of the soft parts were interviewed to establish exposure to phenoxy acids.	Study indicates that exposure to phenoxy acids may comprise a risk factor in the development of malignant mesenchymal tumors of the soft parts.
*Malignant Lymphoma and Exposure to Chemical Substances Especially Organic Solvents, Chlorophenols and Phenoxy Acids. L. Hardell, M. Eriksson and P. Lenner. Lakartidningen 77(4): 208-210, 1980.	A case-control study to investigate the relationship between malignant sarcomas for 169 tests and 335 controls.	A relative risk of 4.8 for exposed vs. non-exposed for phenoxy acids.

Studies that have been conducted in non-industrial settings have not b able to prove a cause and effect relationship between exposure to TCDD and/ 2,4,5-T and specific health effects. The National Academy of Sciences (NAS) was directed by Congress [P.L. 91-441, sec. 506(c)] to conduct a study on the effects of herbicides in South Vietnam, including health effects. This NAS study, as well as at least three other similar studies that were conducted in South Vietnam during the early 1970s, were unable to find adequate data upon which to reach any conclusions concerning a causal effect between exposure to herbicides and any health effects, including birth defects. However, the NAS did express concern over finding low levels of dioxins in fish and shellfish taken from rivers in South Vietnam. An explosion in a Hoffman-LaRoche chemical plant in Seveso, Italy in July 1976 caused approximately 2,000 people to be exposed to TCDD as a toxic cloud drifted across approximately 5 km x 700 m of the Italian countryside. Animals began to die 2 to 3 days after the incident with over 1,100 animals killed by direct exposure to TCDD. Over 700 people were evacuated from their homes. All but two of the 187 children who contacted chloracne have recovered. Long-term human health effects of exposure to TCDD at Seveso are still being studied. Preliminary findings reported in 1979 by Hoffman-LaRoche, revealed that Seveso residents had suffered liver damage but that there was no permanent breakdown in liver function. They also reported that rates of spontaneous abortions, fetal malformations, congenital defects, chromosome aberrations, reactions to infectious disease, and morbidity and mortality were not affected by TCDD exposure. The data available on fetal malformations was limited by the fact that many women may have gone abroad for abortions, due to Italy's religious restrictions against terminating pregnancies. Official government figures following the Seveso incident support the Hoffman-LaRoche findings regarding the rate of congenital birth defects. The Italian government reported 90 malformations and 24 "doubtful" cases in 2,777 births in 1978 compared to 44 malformations and 25 "doubtful" cases in 2,756 births in 1977. The data suggest a slight increase, but this variation remains within the norm for western Europe. The official figures, however, have been disputed by a group of scientists and Seveso citizens who claim that the number of malformations is three times the figures released by the Italian government. Additional health data is being collected but it has not yet been analyzed to the point that any conclusions can be drawn about the chronic effects of human exposure to TCDD. Some scientists claim that the lack of reliable background data for the exposed area will make any evaluations difficult. The Environmental Protection Agency (EPA) announced the emergency suspension of the domestic use of 2,4,5-T on forests, pastures, and rights-of-way on Mar. 1, 1979, based upon a recently completed epidemiological study that showed a statistically significant (but not strong enough to be a cause and effect) relationship between the spring spraying season with 2,4,5-T in the forests surrounding Alsea, Oregon and a high miscarriage peak that follows the application by 2 to 3 months. This study, however, has been criticized on methodological grounds by various groups, including EPA's own Science Advisory Panel. The EPA had previously decided to take action to restrict the use of 2,4,5-T (with its TCDD contaminant) because animal studies showed that it caused cancer and birth defects, although it needed human data (such as the Alsea study) to impose an emergency suspension (which is the strongest action that the EPA can take against a pesticide). The Alsea study has been cited as showing the first correlation between 2,4,5-T (and presumably its TCDD contaminant) and teratogenic effects in humans. EPA hearings on cancellation of 2,4,5-T began Mar. 14, 1980 and testimony from interested parties is currently being heard.

Exposure in Vietnam

In the early 1960s, the Air Force began to explore the feasibility of using aircraft to spray herbicides in South Vietnam for the purpose of defoliating jungle growth to deprive the enemy of ground cover and to destroy enemy crops to restrict food supplies. After preliminary evaluation in the United States, the first trial missions were run in South Vietnam beginning in January 1962. Various combinations of herbicides and delivery systems were evaluated during the period 1962 to 1965, at which time the Air Force decided to mainly use the herbicide code named "Agent Orange" (a 50:50 mixture of 2,4,5-T and the herbicide 2,4-D) sprayed from airplanes that could carry 1,000 gallons of herbicide and deposit 3 gallons per acre on swaths 240' wide for defoliation and crop destruction missions. The amount of herbicides used increased steadily with a relatively slow buildup from 1962 to 1965, a rapid increase from 1965 to 1967 at which time usage peaked, a slight decline in 1968 and 1969, a sharp drop in 1970, and the end of all aerial spraying in 1971. Approximately 107 million pounds of herbicides were aerially disseminated on 6 million acres of South Vietnam (an area about the size of Connecticut) from January 1962 to February 1971 [the Department of Defense (DOD) maintains that no herbicides were sprayed in North Vietnam]. Approximately 276,000 gallons of Agents Green, Pink, and Purple were sprayed in South Vietnam prior to 1965 when they were replaced by Agent Orange. Approximately 11 million gallons of Agent Orange were then sprayed in South Vietnam -- making it the most widely used herbicide of the war.

Although it was reportedly relatively unknown at the start of the herbicide spraying program in South Vietnam, 2,4,5-T contains an extremely toxic contaminant known as tetrachlorodibenzo-para-dioxin (TCDD). The total amount of 2,4,5-T sprayed in Vietnam contained about 368 pounds of TCDD, as estimated by the Air Force, and possibly more, as implied by the NAS (the NAS estimates that 220 to 360 pounds of TCDD were released over South Vietnam from August 1965 to February 1971 which apparently does not include the TCDD that was released between 1962 to 1965 in Agents Pink, Purple, and Green). About 143 pounds of TCDD (approximately 40%) has been estimated to have been contained in the Agents Purple, Pink, and Green which were sprayed on 90,000 acres of South Vietnam from 1962 to 1964. The remaining 225 pounds of TCDD (approximately 60%) was estimated to have been contained in the Agent Orange which was sprayed on 3.5 million acres of South Vietnam from 1965 to 1970. Ninety percent of Agent Orange was sprayed on 2.9 million acres of inland forests and mangrove forests for defoliation, 8% was sprayed on enemy crops for crop destruction, and the remaining 2% was sprayed around base perimeters, cache sites, waterways, and communications lines.

To illustrate the manner in which herbicides were used in South Vietnam, the NAS tabulated the following data on Agent Orange use for the period of August 1965 to April 1970 from information supplied by the Department of Defense (DOD):

TARGET	NO. MISSIONS	GALLONS	ACRES (may be counted twice if sprayed twice)
defoliation	2,962	9,788,802	3,103,693
crops	427	881,570	265,201

perimeter	335	98,967	32,989
cache site	101	43,080	14,360
waterways	51	25,405	8,468
lines of communication			
friendly	42	24,555	8,185
enemy	32	21,635	7,211
not stated	1	2,700	592
TOTAL	3,951	10,886,714	3,440,107

The Air Force continued to operate its herbicide spraying program in South Vietnam until the late 1960s when the National Cancer Institute released results of an animal bioassay that showed 2,4,5-T to be teratogenic and/or fetotoxic in rodents, and newspapers in South Vietnam started reporting health problems among the rural populations who had been exposed to such herbicides. The Air Force first restricted the use of Agent Orange to areas remote from populations in October of 1969, then stopped all airplane spraying of Agent Orange in early 1970 and all helicopter spraying of Agent Orange by late 1970. All remaining herbicide stocks were gathered and stored at either Gulfport, Mississippi or Johnston Island in the Pacific until they were incinerated at sea in 1977.

The following major military projects involved the handling of Agents Orange, Purple, Pink, or Green in support of military programs in South Vietnam:

PROJECT	DATES	DESCRIPTION
AGILE	1960-68	Selection of herbicides, and development and evaluation of defoliation techniques.
RANCH HAND	1962-71	Aerial spraying of herbicides in South Vietnam.
Various USAF Projects	1962-70	Development and testing of aerial spray equipment.
PACER IVY	1971	Redrumming and movement of surplus herbicide from South Vietnam to Johnston Island.
AFLC project on disposition of		

Agent Orange	1972-77	Maintenance of herbicide inventory and research on options for disposal.
PACER HO	1977	Dedrumming of herbicide inventory and at-sea incineration of Agent Orange.

Each of these projects involved some human exposure to the herbicide 2,4,5-T and its contaminant, TCDD. The difficulty lies in determining who may have been exposed and at what level.

Exposure -- Personnel Exposed

The early trials that were conducted in South Vietnam to improve aircraft spray systems (1960 to early 1962) were conducted by USAF personnel assigned to the Special Aerial Spray Flight Division, Langley A.F.B., Va. (USAF personnel engaged in the herbicide program did not receive permanent change of station assignments to South Vietnam until 1964 -- thus making it more difficult to track personnel who may have been exposed to herbicides). During late 1962 and early 1963, the Crops Division at Fort Detrick and the USAF Armament Laboratory at Eglin Air Force Base, Florida were involved in efforts to provide improvements in spray system components in support of Operation RANCH HAND.

Most of the personnel involved in the actual handling of herbicide drums were Vietnamese. However, a USAF flight mechanic or crew chief was responsible for ensuring that the aircraft were properly loaded and that the spray systems were functional. Approximately 0.1% of the herbicide drums were reported to be damaged and 0.05% leaked.

Once the herbicide drums were emptied, the drums were inverted over receptacles to collect any herbicide residues which were then used for spraying base perimeter areas and minefields. The empty drums were filled with sand or concrete and used by friendly military forces for constructing bunkers, or foundations for runways and barbed wire perimeters. Surface areas contaminated by spillage of herbicides were flushed with diesel drainage being directed into settling basins or pits for incorporation into the soil. Although it is difficult to measure small amounts of TCDD in the environment, it is estimated that TCDD in 2,4,5-T can be degraded in as little as 6 hours on plant leaves (with sunlight) or can last as long as 1.5 years on the forest floor. One study has shown that only about 6% of the herbicides sprayed on jungle canopies ever reached ground level. Because TCDD is reportedly not mobile in soil, it does not present a great risk of contaminating ground water. However, low levels of TCDD have been found in fish from the Dong Nai River and shellfish from the Saigon River (both rivers contained waters that flowed from heavily sprayed areas) shortly after large-scale herbicide spraying ceased in South Vietnam.

Each herbicide aircrew consisted of a pilot and a copilot (both usually officers) and a flight mechanic/spray unit operator (usually enlisted). The aircrews were frequently joined by South Vietnamese and U.S. observers. As noted in a USAF report, "within the aircraft, it was not uncommon to have herbicide leakage from around the numerous hose connections joining the spray tank and pumps with the wing and aft spray booms. In hot weather, the odor of herbicide within the aircraft was decidedly noticeable."

The USAF has data on 6,542 herbicide spraying missions that took pl between August 1965 and February 1971 on its "HERBS" computer tape. Th data was compiled on a mission-by-mission basis from reports and files in various commands and offices in South Vietnam and the United States. The HERBS tape contains the following data for each mission: date; mission number; location; province and UTM coordinates; type of herbicide (basically, Agents Orange, White, or Blue); quantity of herbicide; area covered; purpose of mission (defoliation, crop destruction, etc.); and type of aircraft (plane or helicopter). The NAS used the HERBS tape in its evaluation of the effects of herbicides on South Vietnam. After evaluating the HERBS data, the NAS concluded that the HERBS tape accounted for approximately 86% of all herbicide operations in South Vietnam and that "despite certain recognized deficiencies," the HERBS tape is "a reliable source for an assessment of the major part of the herbicide operation in South Vietnam" and "is the best and in fact the only available comprehensive computation of the major part of the herbicide operations conducted in the Vietnam war."

When the DOD suspended all use of 2,4,5-T in South Vietnam, the USAF was left with an inventory of 2.22 million gallons of unused Agent Orange (1.37 million gallons which had been shipped to South Vietnam and 0.85 million gallons which were waiting to be shipped at the Naval Construction Battalion Center at Gulfport, Mississippi). In April 1972, the 1.37 million gallons of Agent Orange were moved from South Vietnam to Johnston Island in the Pacific Ocean for storage. The total amount of TCDD in the remaining Agent Orange stock was approximately 44.1 pounds. Problems began to arise in both locations as drums reportedly began to leak and the USAF expressed concern over further leakage problems that could occur if a tornado hit the Mississippi site or if a typhoon hit the Pacific site. After exploring a number of options, the USAF decided to dispose of the Agent Orange by burning it at high temperatures at sea on the Dutch incinerator ship named the "Vulcanus." The Agent Orange was drained from the drums at each site and transferred to the Vulcanus. The empty drums were then rinsed with diesel fuel and crushed. The rinse fluid was combined with the Agent Orange for incineration at sea. A total of 15,480 drums of Agent Orange were processed at the Mississippi site between May 24, 1977, and June 10, 1977, by approximately 110 U.S.A.F. officers/technicians from the five Air Logistics Centers of the Air Force Logistics Command (located at Kelly A.F.B. Texas; Hill A.F.B., Utah; Robbins A.F.B., Georgia; Tinker A.F.B., Oklahoma; and McCellan A.F.B., Cal.). A total of 24,795 drums of Agent Orange were processed at the Johnston Island site between July 27, 1977, and Aug. 23, 1977. Approximately 100 civilian employees hired by a contractor performed the dedrumming process. At both the Johnston Island and Mississippi sites, workers were provided with daily changes of work clothes and some with protective clothing. The Agent Orange was incinerated at sea in the period from July to September 1977.

Dept. of Defense Efforts

The USAF has stated that it can now identify approximately 1,200 servicemen who were directly exposed to Agent Orange as they handled herbicide containers and flew spraying missions in South Vietnam. The Air Force has initiated a health effects study of Air Force personnel involved in operation "Ranch Hand," who sprayed Agent Orange in Vietnam. The Department of Defense (DOD) believes that these individuals had the greatest potential for exposure. The epidemiological study will try to determine whether a causal relationship can be established between exposure to the 2,4-D-2,4,5-T

ure and long-term health effects. Although the study was originally eduled to begin in October 1979, peer review of its protocols forced elays. The University of Texas School of Public Health, the U.S. Air Force Scientific Advisory Board and the Armed Forces Epidemiological Board reviewed the study protocols and recommended modifications. Then the Air Force asked the National Academy of Sciences (NAS) to review the protocols. On May 6, 1980, the NAS announced recommendations that the scope and duration of the study be expanded to increase the likelihood of obtaining definitive data. NAS also expressed concern about the public perception of credibility and impartiality of a study conducted internally by the Air Force. The Interagency Group's Scientific Panel, however, has recommended that the study, as designed by the Air Force, be conducted because, despite its limitations, it provides "a focus as to the type of health effects that may possibly occur in other (ground troop) personnel.

A medical history questionnaire, which has been developed by a contractor, is currently being reviewed and refined. The questionnaires will be filled out by both the Ranch Hand study group and a control group during personal interviews beginning in March 1981. Control group participants are now being selected from military service records held by the Air Force. When the questionnaire section of the study is completed, the study and control group members will be given a 4-day series of physical examinations to determine the status of their health.

Many of the veterans who have filed claims with the VA for compensation for health effects caused by exposure to TCDD in South Vietnam did not hold jobs that caused direct exposure to 2,4,5-T. They claim that their exposure occurred indirectly either by being sprayed with overhead planes (although substances other than herbicides were also sprayed from planes) or by being exposed to 2,4,5-T in the environment. According to the DOD, military personnel did not usually enter areas sprayed with Agent Orange until 4 to 6 weeks after treatment. However, a recent General Accounting Office investigation concluded that a large number of Marines in the I Corps section of Vietnam from 1966-1969 were in, or close to, areas sprayed with Agent Orange on both the day of spraying and within 4 weeks afterward. Some Army units were also close to Agent Orange spraying.

Veterans' Problems and Veterans Administration Efforts

The first reports of veterans' concerns over health effects of exposure to ,4,5-T began to appear in late 1977 and early 1978. Veterans have ssociated the following illnesses with exposure to 2,4,5-T: skin onditions; fatigue; nervousness; numbness in extremities; vision and/or earing impairments; birth defects in offspring; reduced libido; iscarriages; impotency; respiratory problems; gastro-intestinal tract isturbances; and various cancers as well as a variety of other illnesses.

As of Nov. 30, 1980, the VA had received 5025 claims for damages eportedly related to in-service exposure to herbicides. Nine hundred and orty-two claims have been made due only to exposure to the herbicides and ot for any specific condition. 4,083 claims have been filed for specific onditions related to herbicide exposure. Of those 4,083 claims filed, 2,415 eterans have filed claims for various skin conditions; 2,351 for ervousness, headache, or fatigue; 753 for paralysis or numbness; 626 for astro-intestinal or genito-urinary conditions; 320 for various malignancies; 37 for impaired sexual activity; 334 for eye, ear, nose, and throat onditions; 236 for respiratory conditions; 183 for cardio-vascular

conditions; and 114 for miscellaneous conditions. Many of the veterans filed for multiple conditions. 4,060 out of 4,083 specific claims have been denied. Out of the 23 claims that have been allowed, 4 claims have been allowed due to chloracne, based on possible herbicide exposure. The other 19 cases were allowed on the basis of conditions found in-service that are not associated with herbicide exposure. The VA has not awarded compensation for the claims of chronic illnesses related to Agent Orange exposure for two reasons: (1) the lack of valid human data to prove a cause and effect relationship between exposure to 2,4,5-T-2,4-D and/or TCDD and specific chronic health effects; and (2) the difficulty of determining which veterans have and have not been exposed to Agent Orange.

VA hospitals and health care facilities are reportedly examining and treating all veterans who claim to have toxic effects from exposure to herbicides during the Vietnam war, although some veterans claim that their treatment has been inadequate. The VA is now developing a list of all Vietnam veterans who have been treated for herbicide-related health problems. As of June 1980, approximately 12,000 veterans have requested examination at VA facilities. Those veterans on the lists and those requesting assistance will be asked to go to a VA health facility for a standard physical examination. These individuals will be examined once a year for five years to determine if they are suffering any symptoms which may be related to Agent Orange exposure. The VA is collecting data from examination results and medical histories as well as saving tissue samples (in a special tissue registry) from veterans to discover any correlations. The VA is also going through its past patient treatment information to determine if Vietnam veterans have an increased rate of any specific diseases (such as skin disorders, birth defects, and cancer). In response to a congressional request, the VA plans to reexamine medical files of those Vietnam veterans who claim to have skin problems and already have been examined. Those who show signs of chloracne will be invited to a local VA facility for reexamination by a dermatologist. Examinations began in July. The VA has also formed numerous interagency committees to advise the Administration on its role in the Agent Orange problem.

The VA has completed a pilot study to determine if TCDD can still be found in the body fat tissue of veterans who were exposed to Agent Orange by comparing tissue samples from-exposed veterans to nonexposed veterans. The veterans were randomly selected from the Chicago area. Results of mass spectrometry analysis (a chemical identification technique) have been validated for 23 biopsies. Seven of the 23 were controls and one of the controls had low levels but detectable levels of dioxin. Of the remaining 16 validated samples, all study cases, about one-third had significant detectable levels in the range of 3 to 19 parts per trillion. These results have been reviewed by the Scientific Panel of the Interagency Work Group on Phenoxy Herbicides and Contaminants who questioned the verity of TCDD results from both a quantitative and qualitative standpoint. Caution must be used in interpreting these results because the figures obtained are at the current technological limits of detection and dioxin contamination is so ubiquitous it may likely be found in everybody's fat tissue. If this fat tissue test is validated as a measurement of exposure, the VA may use it on larger groups of veterans to determine any significant residues of TCDD. However, the test will not be without problems. Exposed veterans with negative results may have levels of TCDD that are too low to detect or the TCDD may have already caused an adverse effect (such as initiating cancer) and subsequently been eliminated from the body. Unexposed veterans with positive results for TCDD may have come in contact with 2,4,5-T in civilian life (2,4,5-T was registered for various domestic uses until Mar. 1, 1979), thus making it hard

establish a military connection.

As mandated in P.L. 96-151, the Veterans' Affairs Amendments, the VA is currently planning to perform an epidemiological study of Vietnam veterans exposed to Agent Orange. Although the study's protocol will be developed and validated by an independent group, the VA will perform the testing and collect the data. Procurement of an independent contractor for the study's protocal and data interpretation was delayed for 14 months by a protest filed by the National Veterans Law Center (NVLC). The NVLC alleged that not only was the VA violating procurement law, but also the study as currently contemplated did not comply with the requirements of P.L. 96-151. On Feb. 2, 1981, the General Accounting Office concluded its investigation and denied the NVLC protest. The VA can now proceed with its congressionally mandated epidemiological study. The VA Literature Review of Studies on 2,4,5-T and dioxin is underway and will be completed in September 1981. The White House Interagency Group on Phenoxy Herbicides and Contaminants, established in December 1979, has recommended that the Center for Disease Control perform a case-control study to see if there is an increased incidence of specific malformations in children of Vietnam veterans. The study will use CDC Congenital Defects Program data to determine whether, in general, the population of offspring of Vietnam servicemen has an increased malformation incidence. The study has been initiated and the White House Workgroup Scientific Panel has reviewed its protocol, and CDC is awaiting OMB clearance.

In its fourth report to the White House, the Work Group's Scientific Panel concluded that "an additional two or three years of research will be required to expand significantly scientific knowledge about the long-term health effects of Agent Orange." "Current scientific knowledge does not permit unequivocal judgments as to the health risks associated with each of the wide spectrum of health effects alleged to have resulted from exposure to herbicides or their dioxin contaminations. On Sept. 22, 1980, the Work Group held its first public meeting to discuss problems and proposals related to exposure to herbicides.

Because the VA currently recognizes only chloracne as a human health effect that can be proven to be caused by exposure to 2,4,5-T, even veterans who can prove their exposure to 2,4,5-T may have difficulty being compensated for even those effects for which there is strong animal evidence (i.e., cancer and birth defects caused in utero which are those birth defects that can not be caused by the father and require the mother and fetus to be exposed during the actual pregnancy). Veterans who claim compensation for health effects which are not supported by strong animal data (i.e., mutations -- which could cause genetic defects in the father's sperm that would affect children conceived after exposure) may have an even tougher case to argue.

The veterans' question then becomes: How much data is required to prove the right to compensation? On whom does the burden of proof lie (the veteran or the VA)? If more data is needed, who will generate it? Will it be necessary to establish a direct link with 2,4,5-T exposure or will service in Vietnam be considered sufficient for consideration as part of a higher risk group as recommended by the Interagency Workgroup on Phenoxy Herbicides? And finally, what constitutes fair treatment of veterans while any necessary data is being gathered?

Congressional Action of the 96th Congress

The 96th Congress responded to the problems of establishing a cause effect relationship between veterans' exposure to herbicides in South Viet and the various health effects they are now experiencing by holding hearing and enacting legislation.

The Subcommittee on Oversight and Investigation of the House Committee on Interstate and Foreign Commerce held hearings on June 24 and 25, 1979, to hear testimony from veterans who allegedly have been affected by herbicide exposure and from the Veterans' Administration regarding their efforts to unequivocally determine the relationship between herbicide exposure and health effects. The Subcommittee on Medical Benefits and Facilities of the House Committee on Veterans' Affairs held two sets of hearings on the hazards associated with TCDD, veterans' complaints of health effects associated with Agent Orange exposure and Veterans' Administration's efforts to resolve the Agent Orange problem.

The Senate Veterans' Affairs Committee also held hearings to examine the Agent Orange problem.

As a step to gain access to records to locate veterans who may have been exposed to herbicides inservice, Title V of H.R. 2282, the Veterans' Disability Compensation and Survivors' Benefits Amendments of 1979, requires the Director of the National Institute for Occupational Safety and Health, upon request by the VA (or other appropriate agency) to request the current mailing address from the Internal Revenue Service of persons whom the VA certifies may have been exposed to occupational hazards. H.R. 2282 was passed in lieu of its companion bill, S. 689, and became public law 96-128 on Nov. 28, 1979.

Title III of H.R. 3892, the Veterans' Affairs amendments, directs the Veterans' Administration to conduct an epidemiological study of the long-term health effects on individuals from exposure to dioxins in Vietnam, upon the Office of Technology Assessment's (OTA) approval of its protocol. Its companion bill, S. 1039, was incorporated in H.R. 3892 as an amendment, and the measure was enacted by Congress and signed by the President on Dec. 20, 1979 (P.L. 96-151).

If enacted, S. 2096 would have directed the Secretary of Health, Education, and Welfare (now, Health and Human Services) to undertake an epidemiological study to determine the long-term adverse human health effects associated with exposure to dioxins produced during the manufacture of phenoxy herbicides. This bill proposed to investigate the long-term health effects of exposure to dioxins, in general, not just to Agent Orange. As similarly incorporated in H.R. 3892, S. 2096 would have required that the study's protocol be approved by the Congressional Office of Technology Assessment. This bill was presented to the President on Dec. 21, 1979, and vetoed by him on Jan. 2, 1980. President Carter vetoed the bill because White House counsel believed that there was a lack of separation of power between the congressional branch and the executive branch. In carrying out its mandate, the Department of Health and Human Services' study protocol would have been subject to approval by a congressional agency.

Title X of H.R. 5288, the Veterans' Rehabilitation Program and Veterans' Educational Assistance Program would have directed the Secretary of Health and Human Services to conduct a study of veterans and other groups exposed to the herbicide known as "Agent Orange" to determine if there may be adverse health effects associated with such exposure. Like H.R. 3892 (P.L. 96-151) and S. 2096, the bill called for OTA approval of the study's protocol. The

bill also would have required the Secretary of Health and Human Services to coordinate its efforts with other studies in the Federal Government. During the debate on S. 1188, the Disabled, its companion bill Veterans' Rehabilitation Act, the Senate adopted an amendment offered by Senator Cranston to expand the study on health effects of exposure to Agent Orange to include other factors related to service in Vietnam. The Senate also adopted an amendment offered by Senator Heinz requiring the VA to promulgate regulations regarding guidelines to resolve veterans' disability claims based on exposure to Agent Orange. The amendments were striken by the House because they were considered to be "non-germane" to the primary focus of the bill.

S. 1872 (the Vietnam Veterans' Act); H.R. 6050 (the Vietnam Veterans' Act); H.R. 6377 (the Vietnam Era Veterans Agent Orange Act); each would have established a presumption of service-connected disability for health effects in Vietnam veterans (and birth defects in their children) exposed to Agent Orange. H.R. 8238 (Independent Agent Orange Study) would have directed the Veterans' Administrator to request the National Academy of Sciences to conduct a study on veterans exposed to Agent Orange. H.R. 8300 would have expanded the scope of the Agent Orange study currently being coordinated by the VA and would have established deadlines for promulgating regulations related to Agent Orange exposure claims. These bills received no action.

LEGISLATION

H.R. 523 (Roe)

Amends Title 38, U.S. Code, to waive the 1-year limitation on claims for compensation from the Veterans' Administration for disabilities and diseases incurred in or aggravated by military service in the case of claims by veterans who served in Southeast Asia during the Vietnam era for compensation for disabilities resulting from exposure to the phenoxy herbicides known as agent orange or other phenoxy herbicides. Introduced Jan. 5, 1981; referred to Committee on Veterans' Affairs.

H.R. 1173 (Montgomery, by request)

Amends section 307 of P.L. 96-151, by assigning the responsibility of designating a protocol for, and conducting an epidemiological study of, veterans who were exposed to Agent Orange, to an independent scientific agency. Introduced Jan. 22, 1981; referred to Committee on Veterans' Affairs.

H.R. 1962 (Gilman)

Amends the Veterans Health Programs Extension and Improvement Act of 1979 to require the Veterans' Administration and the National Academy of Sciences to enter into an agreement under which the Academy will conduct an epidemiological study of veterans exposed to Agent Orange. Introduced Feb. 19, 1981; referred to Committee on Veterans' Affairs.

H.R. 2157 (Mottl)

Expands the scope of a study required to be conducted by the Administrator of Veterans' Affairs concerning the effect on humans of exposure to the chemical known as agent orange. Introduced Feb. 25, 1981: referred to Committee on Veterans' Affairs.

H.R. 2297 (Downey)

Amends Title 38, United States Code, to waive the 1-year limitation of claims for compensation from the Veterans' Administration for disabilities and disease incurred in or aggravated by military service in the case of claims by veterans who served in Southeast Asia during the Vietnam era for compensation for disabilities resulting from exposure to the phenoxy herbicides known as "Agent Orange" or other phenoxy herbicides. Introduced Mar. 4, 1981; referred to Committee on Veterans' Affairs.

H.R. 2493 (Daschle)

Amends Title 38, United States Code, to provide a presumption of service connection for the occurrence of certain diseases in veterans who were exposed to herbicides in Southeast Asia during the Vietnam era. Introduced Mar. 12, 1981; referred to Committee on Veterans' Affairs.

S. 689 (Heinz)

Amends section 307 of the Veterans Health Programs Extension and Improvement Act of 1979 to require the promulgation of regulations containing guidelines for resolving claims for veterans benefits based on exposure to Agent Orange, and for other purposes. Introduced Mar. 12, 1981; referred to Committee on Veterans' Affairs.

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TABLE I

Signs, Symptoms, and Disorders Reported After Occupational Exposure to TCP, 2,4,5-T or TCDD

Source	Headaches	Sensory Nerves and Tracts	Neuralgia or Myalgia	Paresis	Hemorrhage	Porphyria	Hyperpigmentation or Hirsutism	Acne	Fetal Disorders	Cancer	Asthenia	Other Psychiatric	Abdominal Pain or Pressure	Anorexia, Nausea Vomiting, Diarrhea	Death
Baader and Bauer (6)			8	2				17			4				
Bauer et al. (9)	4[a]	3	6	9			5	8			9	6	5		
Bleiberg et al. (14)						11	18	20							
Poland et al. (62)	8	2		7		1	30	48					+	22	
Dugois et al. (24)	+[b]							17			+		+	+	
Hardell (33)										87					
Kimmig and Schulz (44)				+				31			+				
Kramer (49)	3										4	2			
Jirasek et al. (37)	+		+	+		12	19	78		2	+	+		+	3
Jirasek et al. (38)		+				+						+			
Pazderova et al. (61)			+	+		23	+	53		2	27	8	+	+	3
Miura et al. (54)								+							
Oliver (57)	2	1	1				3	2			3	1	1	1	
Ter Beek et al. (79)	+					+		+			+	+		+	
Zelikov and Danilov (88)								1							
Total number of cases reported[c]	17	6	15	18	0	47	75	275	0	91	47	17	6	23	6

[a]Number entries in table reflect the number of cases in which sign, symptom or disorder was reported. [b]+ = Sign, symptom or disorder reported but number of cases not given.

[c]Numbers do not include cases represented by "+" and totals may represent some double counting due to the overlap to studies by Jirasek et al. and Pazderova et al.

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