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DEPARTMENT OF THE AIR FORCE
USAF OCCUPATIONAL AND ENVIRONMENTAL HEALTH LABORATORY (AFSC)
BROOKS AIR FORCE BASE, TEXAS 78235



7 DEC 1978

REPLY TO
ATTN OF: CC

SUBJECT Review of Draft GAO Report - Herbicide Orange

TO HQ USAF/SG

1. My staff and I have reviewed the draft U.S. General Accounting Office (GAO) report entitled, "Need to Determine Long-term Health Effects of Exposure to the Herbicide Agent Orange in South Vietnam".

2. In general, we understand the concern over determining the long-term health effects of exposure to 2,4-D and 2,4,5-T, the two major components of Herbicide Orange, and its contaminant TCDD (2,3,7,8-tetrachlorodibenzo-p-dioxin). These two herbicides have been used extensively in worldwide agricultural applications over the past 30 years with an admirable record of safe use. In light of this 30-year experience and, in view of the conclusions of the U.S. Air Force Surgeon General's Task Force Report on Herbicide Orange (OEHL-TR-78-92), we believe that the existence of some 445 claims by Vietnam veterans does not constitute a sufficient scientific justification for the course of action recommended by this GAO draft report.

3. The draft GAO report does not clearly differentiate between two distinct needs: (a) the need for a long-term scientific study of the effects of human exposure to TCDD; and, (b) the need for sufficient data to permit a valid and equitable resolution of the claims submitted to the Veterans Administration (VA) by concerned Vietnam veterans. To address the scientific question of what are the long-term effects of exposure to TCDD requires a confirmation that a selected population was, in fact, exposed to TCDD, e.g., the TCDD episodes in Eastern Missouri, Seveso, Italy, and in various industrial accidents. Long-term epidemiological studies are currently underway in some of these episodes and accidents, as reviewed in the Task Force Report. No appropriate military group exists to address the first need. RANCH HAND personnel handled Herbicide Orange; however, there is no way to verify or quantify the exposure any individual or group of individuals may have had to TCDD. The RANCH HAND personnel were not unique in this regard; commercial phenoxy herbicide applicators have also had similar unquantifiable exposure. It is inappropriate, therefore, to suggest that the RANCH HAND personnel could serve as a nucleus for a systematic followup study to determine the long-term effects of human exposure to TCDD. In order to address the second need, we believe it is appropriate at this time to conduct a preliminary assessment of the current health status of RANCH HAND personnel. The questionnaire you requested to be developed by the USAF School of Aerospace Medicine meets this need. The data derived from this questionnaire in conjunction with the present ongoing VA efforts should provide a basis for the resolution of claims.

4. An evaluation of specific items mentioned in the draft GAO report is attached.

WILLIAM E. MABSON, Colonel, USAF, BSC
Commander

1 Atch
Comments on GAO Report

Cy to: AFMSC/SGPA
AFSC/SGP (LtCol Lewis)
AMD/CC
USAF SAM/ESS

USAF OEHL COMMENTS TO THE GAO DRAFT REPORT

'NEED TO DETERMINE LONG-TERM EFFECTS OF EXPOSURE TO THE
HERBICIDE AGENT ORANGE IN SOUTH VIETNAM'GENERAL COMMENTS

1. We feel that a more appropriate title for this document would be "Proposed Study to Determine Need for Data on Long-Term Human Health Effects of Exposure of U.S. Military Personnel to Herbicide Orange in South Vietnam". It is our opinion that insufficient information is available to justify the initiation of a costly and long-term study.
2. The report does not clearly delineate whether the "need" is for human health effects data on the herbicides (2,4-D and/or 2,4,5-T), or just the contaminant TCDD, or both if, in fact, they can be separated. It is our opinion that two different needs exist: (a) the need for a long-term scientific study of the effects of human exposure to TCDD, but not necessarily to the herbicides since sufficient data are available; and, (b) the need for sufficient data to permit a valid and equitable resolution of veterans' claims. A clearer definition of the problem is indicated. Moreover, the distinction is not made between a formulation and the parent chemical. Herbicide Orange was, for example, a formulation of the n-butyl esters of the chemicals 2,4-dichlorophenoxyacetic acid (2,4-D) and 2,4,5-trichlorophenoxyacetic acid (2,4,5-T).
3. The organization of the report is cumbersome. For example, environmental fate of the herbicides is not adequately discussed. Some factors affecting the environmental fate of TCDD are discussed on pages 3-5, 16-17, and 19-20. Another example would be the frequent reference to "other chemicals". All chemicals discussed are pesticides (herbicides and insecticides) and could be listed and briefly discussed under the heading, "Military Use of Pesticides in South Vietnam", (page 1-2).
4. The report frequently does not cite selected literature that would be important in providing information pertinent to the discussion of data needs. Examples of these are provided in the subsequent section on specific comments.
5. The use of the word, "agent", connotes association with antipersonnel chemical warfare agents. It has historically been the policy of the Air Force that defoliants not be viewed as chemical warfare agents. Thus, the term, "Herbicide Orange", is more acceptable.
6. Most all issues addressed in Chapter 2 of the report refer to Veterans Administration (VA) policy and actions. We believe that the report does not sufficiently address some of these VA issues. However, we have chosen not to comment in this area except to refer the GAO to the documentation we have available (Reference: Statement of Paul A. L. Haber to the Committee on Veterans Affairs, House of Representatives, Washington, D.C.,

11 October 1978, and Minutes of the Ad Hoc VACO Advisory Committee on Herbicides meeting of 7 July 1978, Washington, D. C.).

7. A glossary of terms would be helpful to the reader. A proposed glossary is attached.

SPECIFIC COMMENTS

1. Page 1, last paragraph: The reference to "use of TCDD" is inappropriate. TCDD was inadvertently present as a contaminant from the manufacturing process of trichlorophenol, a precursor of 2,4,5-T.

2. Page 2, second paragraph: Department of Defense procurement records more accurately reflect the total herbicide use in South Vietnam rather than the National Academy of Sciences' report which calculated a portion of the quantity used on area of land sprayed. The USAF OEHL Technical Report OEHL-TR-78-92 cited total quantities of herbicides sprayed, based on procurement records less that quantity of herbicide returned from South Vietnam in 1972. Approximately 17.7 million gallons of herbicides were sprayed: 0.28 million gallons were sprayed from January 1962 through 1964, and the remainder sprayed from 1965 through 1971. Total volume of Herbicide Orange sprayed (1965-1970) was 10.65 million gallons. Approximately 44.2 million pounds of 2,4,5-T with its 370 pounds of TCDD were sprayed on approximately 3 million acres of South Vietnam during the years 1962 through 1969. It is worthy of note that during the same period (1961-1969), 78.1 million pounds of 2,4,5-T containing an estimated 1,800 pounds of TCDD were disseminated on approximately 14 million acres of land in the United States.

3. Page 2, third paragraph: Although Herbicide Orange was sprayed undiluted in South Vietnam at the rate of three gallons per acre, much of the aerially applied, water insoluble, spray was deposited on the dense jungle canopy. The amount of herbicide penetrating to the forest floor (six percent of that applied) would have been similar to the levels normally applied to brush-infested ranch land in the United States. Entry into a treated area by military personnel in South Vietnam could then be viewed as similar to entry into defoliated brush-infested ranch land in the United States, treated with 2,4,5-T. (Reference: Statement of Major General Garth B. Dettinger to the Committee on Veterans Affairs, House of Representatives, Washington, D.C., 11 October 1978).

4. Page 2, fourth paragraph: It is implied that all domestic uses of 2,4,5-T were restricted in 1970. This is incorrect. The 1970 suspension of the use of 2,4,5-T applied only to uses around the home, around water sources, and on most all food crops (rice excepted). Registered uses of 2,4,5-T for control of weeds on rangeland, pastures, forests, rice, rights-of-way, and nonagricultural lands remains in effect.

5. Page 3, first paragraph: The range of TCDD in Herbicide Orange was

from <0.02 to 47 ppm with a weighted mean concentration of 1.98 ppm. The surplus herbicide was disposed of by at-sea incineration.

6. Page 3, second paragraph: In regard to the environmental fate of TCDD, Nash and Beall (Nash, R.G. and M.L. Beall, Jr., 1978. Environmental distribution of 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) applied with silvex to turf in microagroecosystem. Final Report EPA-1AG-D6-0054, Agricultural Environmental Quality Institute, U.S. Department of Agriculture, Beltsville MD) found that volatilization of TCDD was probably a major pathway of dissipation. However, once TCDD was volatilized, it dechlorinated in the direct sun and apparently even in shade outdoors. Thus, TCDD is sensitive to photodechlorination in the vapor phase even without the presence of ultraviolet light. The significance of these data is that most TCDD sprayed into the environment during defoliation operations in South Vietnam probably degraded into innocuous products within 24 hours of application.

7. Page 3, third paragraph: The implication is that one part per trillion of TCDD exerts biological effects. However, scientific literature is available stating that "no effect" dosage levels have been established. For example, Kociba, et al (Kociba, R.J., et al, 1978. Results of a two-year chronic toxicity and oncogenicity study of 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) in rats, Toxicol. Appl. Pharmacol. In Press) found that no toxic effects were produced when 0.001 ug/kg TCDD was given to rats via the diet for two years.

8. Pages 3-4, Air Force Studies: For clarity and relevance of the data, the additional number of soil samples and the paragraph on gross pathology of all species containing TCDD should have been included. The source of these data is an abstract of a presentation (Young, A.L., C.E. Thalke and D.D. Harrison, 1978. Persistence, bioaccumulation, and toxicology of TCDD in an ecosystem treated with massive quantities of 2,4,5-T herbicide. Symposium on Avian and Mammalian Wildlife Toxicology, Meeting of The American Society of Testing Materials, New Orleans LA, 17 October 1978, Abstract) and is attached for your information.

9. Page 4, third paragraph: The levels of TCDD in fish, crustaceans, and human milk reported by Baughman and Meselson in samples collected in 1970 from South Vietnam were never confirmed. No other laboratory confirmed the levels reported. In March 1978, Meselson and Baughman noted that previous extraction techniques may not have permitted the separation of TCDD from PCBs. (Reference: Meselson, M. and R. Baughman, 1978. The evaluation of possible health hazards from TCDD in the environment. Symposium on the Use of Herbicides in Forestry, Arlington VA, 21-22 February 1978).

10. Page 5, third paragraph: Ground combat forces and combat helicopter elements were routinely exposed to aerially applied insecticide and smoke screens immediately prior to and during air and ground assault operations. The insecticides (primarily malathion) were for the purpose of reducing mosquito populations in an attempt to control malaria and the smoke screens were to provide camouflage. Herbicides were not used in this

fashion. (Reference: Statement of Major General Garth B. Dettinger to the Committee on Veterans Affairs, House of Representatives, Washington, D. C., 11 October 1978).

11. Page 6, second paragraph: It would seem appropriate to qualify the DoD position with regard to the identification of the 400 RANCH HAND personnel as being a group "more likely to have been exposed" in Vietnam. RANCH HAND personnel constitute a readily identifiable group that had direct, routine association with the Herbicide Orange operations. Identifying this group as the more likely to have been exposed should not necessarily suggest that the levels of exposure of RANCH HAND personnel were abnormally high. In fact, we believe that the Herbicide Orange ground handling and aerial operations conducted by RANCH HAND personnel in South Vietnam can be viewed as similar to those conducted during the ground handling procedures used for the Herbicide Orange disposal operations completed in 1977. These disposal operations were monitored extensively. Ambient air sampling programs of these dextrunning/transfer operations revealed that under the worst case noted, the levels of 2,4-D and 2,4,5-T vapors were well below the TLV (time-weighted Threshold Limit Value) for each of these materials. The noted levels were at least two and, in most cases, three orders of magnitude below the TLVs. TCDD was not detected in any air samples. It is reasonable to conclude that the levels of exposure to RANCH HAND personnel would not have been any different than the levels noted during the 1977 disposal operations. (Reference: See Major General Dettinger's Statement of 11 October 1978, Technical Report USAF OEHL-TR-78-92).

12. Page 6, third paragraph: Reference is made to the 450 letters received from citizens and environmental groups protesting the domestic use of 2,4,5-T. Subsequent mention of the EPA RPAR of 2,4,5-T implies that contrary positions were few and insignificant. EPA has received an extraordinary amount of data and replies in favor of the continued registration of 2,4,5-T. Some of the most significant replies have been from the Council for Agricultural Science and Technology (CAST), National Forest Products Association, and the American Farm Bureau, all attesting to the safety and economic benefit of the use of 2,4,5-T. (Reference: Mullison, W.R., 1978. The 1978 Update of 2,4,5-T. Down-to-Earth 35(1):10-13).

13. Page 7, second paragraph: The statement that "Actions to resolve individual claims and to develop policy have been hampered by limited information on the long-term health effects of herbicides . . ." is not fully supportable. There exists in the scientific literature some significant studies on the consequence of human exposure to the phenoxy herbicides. Technical Report USAF OEHL-TR-78-92 discusses studies on the pharmacodynamics and toxicity of 2,4-D and 2,4,5-T in humans. Adverse effects from exposure to 2,4-D and 2,4,5-T manifest themselves shortly after exposure. The effects are transitory. Long-term studies of the health of workers in 2,4,5-T manufacturing plants and workers involved in the spraying of these herbicides in Sweden and Finland have all shown no significant increase in adverse effects or overall mortality. It should be emphasized that the domestic and worldwide use of 2,4-D and

2,4,5-T for the past 30 years has not resulted in a documented, marked increase in illness among users or the general population.

There were reported

14. Page 14, third paragraph: The statement, "Chloracne is considered as a sign of potential systemic poisoning and environmental hazard" needs clarification. Perhaps a more appropriate way of stating this would be:

"Chloracne is considered to be a sign of potential systemic poisoning and an indication of exposure to TCDD or some other chloracnigen".

Discussion of "environmental hazard" is out of place under the topic, Dermatological Disorders.

15. Page 16, second paragraph: Special emphasis has been placed on miscarriages by having a separate section on "EPA Evaluation of Reports of Miscarriages"; however, some excellent epidemiological studies have been conducted in Australia, New Zealand, and Italy. No reference is made to these studies, yet they contain a wealth of information. References include:

a. Reggiani, G., 1978. The estimation of the TCDD toxic potential in the light of the Seveso accident. Paper presented at the 20th Congress of the European Society of Toxicology. Berlin (West), June 25-28, 1978.

b. McQueen, E.G., A.M.O. Veale, W.S. Alexander, and M.N. Bates, 1977. 2,4,5-T and human birth defects. New Zealand Department of Health, Division of Public Health. Mim. 41 p.

c. Consultative Council on Congenital Abnormalities in the Yarram District, September 1978. Report of the Consultative Council on Congenital Abnormalities in the Yarram District. National Health and Medical Research Council, Melbourne, Victoria, Australia. Mim. 55p.

The Australian and New Zealand studies involved investigations initiated in response to allegations that 2,4,5-T and its associated dioxin were responsible for miscarriages and birth defects in women exposed during commercial herbicide operations. The results of both studies were similar. No association could be found between the reported effects and exposure to the herbicide. The Italian study reported by Reggiani concerned 623 women exposed to TCDD following an accidental release from a trichlorophenol manufacturing plant in Seveso, Italy, in July 1976. Two years after the TCDD release, surveillance data have shown no derangement of the gestation, no foetal lethality and loss, no gross malformations, no growth retardation at term, and no cytogenetic abnormalities.

16. Pages 16-17, Toxic Effects of TCDD in Animals: This section is outdated. The citing of the 1974 NAS report is inappropriate. Recent (1978) documents reviewing TCDD toxicity in animals include:

a. Subcommittee on Pesticides and Related Compounds, 1978. Phenoxy Herbicides - their effects on environmental quality with accompanying scientific criteria for 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD). Publication No. NRCC 16075. National Research Council of Canada, Ottawa, Canada.

b. Council for Agricultural Science and Technology, 1978. The Phenoxy Herbicides. Report No. 77. Available from CAST, Agronomy Building, Iowa State University, Ames, Iowa.

c. Environmental Protection Agency, 1978. Notice of rebuttable Presumption Against Registration and Continued Registration of Pesticide Products Containing 2,4,5-T. Federal Register, 43(78):17117-171157.

d. Young, A.L., J.A. Calcagni, C.E. Thalken and J.W. Tremblay, 1978. The toxicology, environmental fate and human risk of Herbicide Orange and its associated dioxin. Technical Report USAF OEHL-TR-78-92. USAF Occupational and Environmental Health Laboratory, Brooks AFB, Texas.

17. Page 19, Air Force Studies: As noted in Specific Comment Number 8, a more recent assessment of the Eglin AFB data is available.

18. Pages 22 and 23, Justifications for Study: The draft report lists three justifications for the needs of a study. These three justifications should be reviewed and perhaps restated in view of the above general and specific comments.

19. Page 23, NAS quotation: The statement that 2,4,5-T is probably the main source of TCDD in the environment needs to be reevaluated in the light of a recent publication on the formation of dioxins by combustion. The October 1978 publication, "The Trace Chemistries of Fire: A Source of and Routes for the Entry of Chlorinated Dioxins into the Environment", was prepared by the Chlorinated Dioxin Task Force, the Michigan Division, Dow Chemical U.S.A. The report concluded that:

a. Refuse incinerators and fossil-fueled powerhouses are sources of both airborne and waterborne particulates which contain chlorinated dioxins.

b. Gasoline and diesel-powered automobiles and trucks are sources of airborne particulates which contain chlorinated dioxins.

c. Fireplaces, charcoal grills, and cigarettes have been identified thus far as sources of particulate matter which contain chlorinated dioxins.

The report further stated that TCDD has been commonly used to mean 2,3,7,8-tetrachlorodibenzo-p-dioxin without recognizing the existence of the other 21 tetra-isomers. The examination of soil samples from five different urban areas revealed the presence of 18 of these isomers including 2,3,7,8-TCDD.

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1. Glossary

2. Abstract

G L O S S A R Y

ABSORPTION	Movement of pesticide from the surface into a plant, animal, or the soil. For instance, in animals, absorption may take place through the skin, the respiratory or digestive systems.
CARCINOGENICITY	The ability to cause cancerous (malignant) tumors.
ESTER	A compound formed by reaction of an acid and an alcohol accompanied by the loss of water formed during the reaction.
FETOTOXICITY	The ability to poison a fetus.
FORMULATION	The pesticide product containing the active ingredient, the carrier, and other additives required to make it ready for use.
HAZARD	The probability that injury will result from use of a substance in a proposed quantity and manner. The sum of the toxicity plus the exposure to a pesticide.
HIGHLY TOXIC	(1) substances are considered highly toxic by law if the LD ₅₀ of a single oral dose in 50 milligrams or less per kilogram of body weight (LD ₅₀); (2) if LC ₅₀ of toxicity by inhalation of 2,000 mcg or less of dust or mist per liter of air or 200 ppm or less by volume of a gas or vapor when administered by continuous inhalation for 1 hour to both male and female rats or to other rodent or non-rodent species if it is reasonably foreseeable that such concentrations will be encountered by man or; (3) if LD ₅₀ of toxicity by skin adsorption of 200 milligrams or less per kilogram of body weight when administered by continuous contact for 24 hours with the bare skin or rabbits or other rodent or non-rodent species as specified.
ISOMERS	Two or more chemical compounds having the same structure but different properties.
LEACHING	Movement of a substance in the soil usually as the result of water movement.

MUTAGENICITY The ability to cause birth defects in future generations.

ONCOGENICITY The ability to cause tumors (either malignant or benign).

PESTICIDE A chemical or mixture of chemicals used to kill or control any plant or animal considered as a pest.

SAFETY The practical certainty that injury will not result from the proper use of a chemical.

SUSCEPTIBILITY The degree to which an organism is affected by a chemical at a particular level of exposure.

SYSTEMIC PESTICIDE A chemical which moves within the plant or animal.

TERATOGENICITY The ability to cause birth defects in a current pregnancy.

TOXICITY The ability to poison.

VOLATILE A compound is said to be volatile when it evaporates (changes from a liquid to a gas) at ordinary temperatures on exposure to air.

PERSISTENCE, BIOACCUMULATION AND TOXICOLOGY OF TCDD IN
AN ECOSYSTEM TREATED WITH MASSIVE QUANTITIES OF 2,4,5-T HERBICIDE*

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Field investigations were conducted during 1973-1978 on a 3.0 Km² military test area (Test Area C-52A, Eglin Air Force Base, Florida) that received 73,000 kg 2,4,5-trichlorophenoxyacetic acid (2,4,5-T) herbicide during the period 1962-1970. No residues of 2,4,5-T were detected (detection limit of 10 ppb) in any soil samples collected during 1971-1972. However, residues of the contaminant, 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) were still present in 1978.

Fifty-four (54) soil samples were collected to a depth of 0-15 cm from throughout the test area. TCDD levels ranged from <10 to 1,500 parts per trillion (ppt). The median concentration was 30 ppt while the mean was 165 ppt. The ecological survey extending over a five-year period documented the presence of at least 123 different plant species, 77 bird species, 71 insect families, 20 species of fish, 18 species of reptiles, 18 species of mammals, 12 species of amphibians and 2 species of molluscs. At least 170 biological samples were analyzed for TCDD, including 30 species of animals. No TCDD was found in any of the plant species examined. However TCDD was found in nine species of animals including two rodent species: beachmouse (300-1,500 ppt, liver) and hispid cotton rat (<10-210 ppt, liver); three species of birds: meadowlark (100-1,020 ppt, liver),

*Abstract, Symposium on Avian and Mammalian Wildlife Toxicology, Meeting of the American Society for Testing Materials, New Orleans, LA, October 17-18, 1978.

Mourning dove (50 ppt, liver), and Savannah sparrows (6 ppt, liver); three species of fish: spotted sunfish (85 ppt, liver), mosquitofish (12 ppt, whole body) and sailfin shinner (12 ppt, whole body), and one reptile, the six-lined racerunner (360-430 ppt, muscle).

Gross pathology was done on all species collected for TCDD residue analyses. Histopathological 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.