



A HISTORY OF THE RANCH HAND EPIDEMIOLOGIC INVESTIGATION



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**OFFICE OF HISTORY
HUMAN SYSTEMS CENTER
BROOKS AIR FORCE BASE, TEXAS
SEPTEMBER 1995**

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The Ranch Hand Memorial located in the Hurlburt Field Air Park near Fort Walton Beach, Florida

PREFACE

Although the Ranch Hand Epidemiologic Investigation is not yet complete, it was deemed wise to capture it after its first 18 years for several reasons. It confirmed that the Air Force did good unbiased medical research. Its methodology served as a model for several national and international studies. The emotional research benefits of the study were also considerable. The concerns of birth defects, cancer, etc., were dealt with from a scientific rather than from an emotional basis. The research benefits of studying the effects of dioxin was a natural resource as well as an important research opportunity. Nowhere else in the world was there a similar repository of blood samples available for further research and study. Finally, this report needed to be written before the retirements of those who pioneered the study. The following is a brief summary; an expanded version is available in the Human Systems Center archives at Brooks AFB in San Antonio, Texas.

I would like to thank all those who agreed to be interviewed including Colonels William H. Wolfe and Judson C. Miner, Dr. Joel E. Michalek and Mr. Vincent V. Elequin. Thanks are also extended to SSgt Eric Grzebinski and Mr. Tom Kerns who helped research and edit the study.

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BACKGROUND

The concept of aerial spraying of chemicals, which became feasible after World War I, led to the subsequent aerial dissemination of herbicides and set the stage for the Agent Orange issue. In fact, aerial chemical spraying was so successful when first used to control insects in Ohio in 1921 that its use spread rapidly in the US. Soon, the military saw its potential in chemical warfare.¹

By the 1930s the Army Air Corps discovered the basic principles of aerial chemical delivery which would guide the use of herbicides in the 1960s. Pilots developed low-altitude delivery tactics and understood the effects of atmospheric convection, wind and temperature on spray missions. The Air Corps was well-prepared to conduct this type of operation when World War II began. However, there were international restrictions and mutual restraint on the use of chemical sprays. But there was some spraying in the Pacific and some experiments tested defoliants.²

In the 1950s, the US undertook research and development in chemical herbicides and delivery equipment. A large capacity spray system needed to be

developed for its carriers, the B-29, B-50, and C-119. In June 1959 an experiment at Camp Drum, New York, proved the value of aerially dispensed herbicides by improving ground visibility for military operations.³

VIETNAM

In April 1961, a crucial decision was made to spray herbicides in Vietnam. By the following November, President Kennedy committed the US to a course of action which led to the extensive use of defoliation and crop destruction in Southeast Asia. Between 1962-1971 a total of 19,114,169 gallons of herbicide was disseminated in South Vietnam.⁴ The spraying covered approximately 6 million acres or about 9% of the country's landmass. During this period, the date and geographical coordinates of each spray path were recorded in a database and stored on magnetic tapes. (These tapes, called the "Herbs Tapes", later provided a basis for ill-fated attempts to measure herbicide exposure in US Army ground troops.) Between 1965 and 1969, an additional 25 herbicide operations were performed over Laos. With the implementation of the Nixon Administration policy of reducing American presence in South Vietnam, herbicide operations were reduced. The last mission was flown on 7 January 1971. By April 1972, the remaining 1,370,000 gallons of herbicide were removed from Vietnam and shipped to Johnston Island in the Pacific. Another

850,000 gallons were retained at the Naval Construction Battalion Center in Gulfport, Mississippi.⁵

When the Air Force received permission from the Environmental Protection Agency for the disposal of the Johnston Island and Gulfport herbicides, a Dutch ship was hired to haul the containers into the middle of the South Pacific for incineration. Upon completion of incineration (3 September 1977) there were only a few 4-ounce archived bottles of the herbicides remaining.⁶

The incineration of the herbicides was, however, only the beginning of the Agent Orange ordeal. The term Agent Orange came from the color of the drums that contained the herbicide. Herbicide drums were identified by a 4-inch-wide circular band of paint colored in correspondence with the type of herbicide they contained. Thus the term Agent Orange. The most frequently used herbicides were coded orange, white and blue.

Within a day or two of the herbicide incineration, the issue of Agent Orange and cancer was publicized. It stemmed from a clerk at a Chicago Veterans Administration Hospital who thought there was a connection between cancer and Agent Orange in Vietnam veterans. She went to the press with her concerns and

soon there were TV programs on the subject. Congressional hearings were held, and at one of those hearings, in October 1978, the Deputy Surgeon General of the Air Force, Major General Garth Dettinger, pledged a medical study of the issue. In fact, he committed the Air Force to a 20-year epidemiologic study of the health of the Air Force veterans who conducted the spray operations in Vietnam. The units responsible for those missions were the Ranch Hand units and the study became known as the Ranch Hand study. Subsequently, it was renamed the Air Force Health Study.⁷

EPIDEMIOLOGIC STUDY

The following year (June 4, 1979), the Air Force made a formal commitment to Congress and the White House to conduct an epidemiologic study of the possible health effects from chemical exposure to Air Force personnel who conducted aerial herbicide dissemination missions in Vietnam. The purpose of this investigation was to determine whether long-term health effects exist and could be attributed to occupational exposure to herbicides used in Southeast Asia.^{8,9}

Investigators in the Epidemiology and Biometrics Divisions at the USAF School of Aerospace Medicine, began developing the protocol in 1979. Following the basic design of a nonconcurrent prospective study, the authors specified a control

cohort of C-130 air and ground crew who served in Southeast Asia during the same time that the Ranch Hand unit was active, 1961 to 1971, but who were not occupationally exposed to herbicides. Controls, called Comparisons in study reports, were matched to the Ranch Hands on date of birth, race, military rank and military occupation.¹⁰

The 20-year investigation includes mortality, morbidity, and reproductive outcome studies. The morbidity investigation was based on a series of physical examinations to be administered in 1982, 1985, 1987, 1992, 1997 and 2002. The mortality study was to be comprised of annual statistical contrasts of Ranch Hand and Comparison survival rates. The reproductive outcomes study was to be based on medical histories of all offspring of these men with emphasis on birth defects, mortality and developmental impairments. There were 1261 Ranch Hand veterans, of whom 1208 were eligible for the baseline examination. The Comparison population numbers 19,080 veterans; 1667 were eligible for the baseline examination.¹¹

The baseline morbidity study in 1982 included an in-home interview of the subject and spouse, and a physical examination of each willing Ranch Hand and his matched comparison. In subsequent examinations, the questionnaire was administered at the physical examination site rather than at the subject's home. Each physical

examination took 3 days and over 300 different health measures were collected for each subject. The study considers many different aspects of health because veterans complaints regarding the effects of Agent Orange exposure were not specific to a particular disease.¹²

ADVISORY BOARD

The protocol was to be reviewed by an advisory board known as the Ranch Hand Advisory Committee. Its eight to eleven members are appointed by the Department of Health and Human Services at the direction of Congress. To solicit members, the Department of Health and Human Services asked Vietnam veterans groups to nominate people to sit on the Board. These academic non-governmental experts provide peer review for study reports and articles.¹³

In 1980, the Science Panel of the Agent Orange Working Group was created as an additional peer review agency. This group, redesignated the Advisory Committee on Special Studies Relating to the Possible Long-Term Health Effects of Phenoxy Herbicides and Contaminants, continues to monitor the conduct of the study.¹⁴

WHO WAS EXPOSED

It was difficult to determine who was exposed to Agent Orange. Because Army veterans made the majority of complaints, efforts were made by CDC to identify exposed Army ground troops. The "Herbs Tapes," giving the date and location of each spray path, led researchers to study Army records to determine the location of our troops during the war in an attempt to construct an exposure index. However, Army records were inadequate for this purpose because they did not identify the location of units below the company line. Unless the units encountered enemy troops, there were no records as to where they were at any given time. Locations of company headquarters were known, but those were poor substitutes for troop locations. The ascertainment of exposure in Army troops is a subject of controversy to this day.¹⁵

Herbicide exposure in Ranch Hand veterans as a group is, on the other hand, self-evident. Additionally, they were much easier to locate because they generally stayed at one base and performed a set mission during the war. Locating Ranch Hand and Comparison veterans for inclusion in the study required studying the historical records of the unit names and then researching the personnel system to identify people assigned to those units. This information was found in the St. Louis Depository where military personnel and medical records were kept. The staff at the

Military Personnel Center, Randolph Air Force Base, assisted us during this phase of the study. After the Ranch Hand units were identified, the Comparison group was selected from veterans who flew or serviced C-130 aircraft in Southeast Asia at the same time (January 1962 through October 1971).¹⁶

One of the major problems of the study involved personnel unit code numbering. When units were deactivated in Vietnam, the same unit code was given to a new unit. This complication was initially discovered after several hundred veterans were mistakenly identified as study subjects. They were notified that they were to be part of the Study and 26 of them had already gone through their physicals before study investigators found and corrected the error.¹⁷

It took 2 1/2 years to identify the populations at risk. Eligibility criteria were very strict. Potential Comparison veterans who worked on the C-130 operations group qualified, but those who worked only a day or two on those planes were excluded.¹⁸

PROTOCOL REVIEWS

There were a number of reviews mandated for the Ranch Hand protocol. The first was the Armed Forces Epidemiology Board. The Air Force Scientific Advisory Board was the second board and gave its review in September 1979. Finally there was a review by the National Academy of Sciences (NAS) on 18 December 1979. According to Colonel William H. Wolfe, who became the director of Aerospace Medicine at the Armstrong Laboratory, the NAS review was difficult because, although the NAS had been given the protocol in advance to read, they limited themselves to a 3-hour review of which 2 hours was spent on writing the report. The Air Force investigators gave a condensed slide presentation and the NAS response was negative. A question and answer session ensued. According to Wolfe, many of the questions asked could have been answered if NAS reviewers had read the protocol more completely. Wolfe believed the review was not fair, although the NAS minority report fully supported the Air Force team and its protocol. The protocol was continually revised through 1980.¹⁹

With the approval of the various review boards, attention turned to resources. Should the study be accomplished in-house, or by contract? By September 1980, Steward Eisenstadt, Director of Domestic Policy Affairs of the Carter administration

recommended that the study be carried out under contract. Study staff spent the latter part of 1980 and the early part of 1981 in developing a questionnaire and letting a contract to administer that questionnaire.²⁰

The National Opinion Research Center won the contract to develop the baseline questionnaire while Lou Harris Associates won the contract to administer it. The first baseline questionnaire was ready on October 9, 1981. Ranch Hands within the San Antonio area were selected for the first interviews. The in-home questionnaire took about 3 hours to complete, while the veteran and spouse interview took another 90 minutes.²¹

THE FIRST EXAM

By January 1982, there were enough completed questionnaires for the first physical examinations to begin. The contract to perform the examinations was awarded to Kelsey Seybold Clinic of Houston, Texas. The first exam occurred on 12 January 1982 in Houston. The baseline examination was conducted as prescribed in the protocol. During the baseline study, methods of data management and quality control were refined and established for subsequent examinations.²²

At subsequent examinations, a prime and subcontractor approach was initiated to remove the burden of monitoring multiple contracts from study staff. The program manager established a team approach requiring all members to participate in quarterly contract reviews.²³

THE EXPOSURE INDEX

Prior to 1987, all statistical analyses compared the health of Ranch Hands and Comparisons and assessed the significance of associations between adverse health and an exposure index within the Ranch Hand cohort. The exposure index was proportional to the number of gallons of herbicide spray during a subjects tour and inversely proportional to the number of men available to do the work during his tour. The index was weighted to reflect the concentration of the dioxin contaminant in the herbicide during the subject's tour.²⁴

DIAGNOSTIC CODING

Diagnostic coding transformed the different medical conditions discovered into a more manageable numeric form for subsequent statistical analysis and translated textual descriptions into a universal code easily identified by reviewers and medical

specialists. Diagnostic coding is applied in all three parts of the study. In the morbidity portion, the different medical conditions such as diabetes or heart disease, discovered through the physical exam are coded according to a standardized protocol. In the mortality study, death certificates and autopsy protocols are coded based on the underlying cause of death statements. In the reproductive outcome study, birth and medical records were retrieved and searched for evidence of birth defects, delays in development, and physical and mental impairments.²⁵

BREAKTHROUGH

A breakthrough came in 1986 when CDC developed a serum dioxin blood test. The following year, the third physical exam used the new blood test as an exposure index in Ranch Hands. The dioxin result is expressed in picograms of dioxin per gram of lipid and is reported in parts per trillion (ppt). All willing Ranch Hands and Comparisons were offered a dioxin assay at the 1987 physical examination. The distribution of dioxin results in the Comparisons was used to establish 10 ppt as the threshold for background exposure; this value is the 98th percentile of the Comparison distribution. It is also the 40th percentile of the Ranch Hand distribution, indicating that 40% of the Ranch Hand cohort have background levels. This fact has altered the interpretation of study results because it suggests that a substantial percentage of the

Ranch Hands may not have received enough exposure in Vietnam to produce elevated dioxin levels today. The issue is not completely resolvable, however, because Ranch Hands with low levels today may have been exposed in Vietnam, but their body burdens decayed to background levels in the intervening period.²⁶

Despite these caveats, the dioxin assay is generally accepted as the exposure index of choice in this study. In Ranch Hands having dioxin levels above 10 ppt, the estimated initial dose was computed using a first order decay model. The current dioxin level and initial level were used in our recent reports to assess the significance of dioxin effects in Ranch Hands.²⁷

THE DENTAL AMALGAM SUBSTUDY

In 1991, Air Force investigators were approached by researchers at the National Institute for Dental Research (NIDR) seeking collaboration in a study of health and exposure to dental amalgam. Dental amalgam is currently under study as a possible source of adverse health effects due to the mercury in amalgam.

Results so far have not indicated large differences in health, mortality or adverse reproductive outcomes of the two groups. However, continued follow-up of these veterans through periodic examinations made this study ideal for dental examinations and assays for inorganic mercury in urine and blood. With additional funding from NIDR and a protocol written by NIDR researchers and reviewed and approved by the Air Force Surgeon General, 50% of the participants at the 1992 physical examination were offered a small stipend to allow NIDR dentists to photograph teeth. From the photographs, an exposure index was constructed based on the number of tooth amalgam surfaces. The index will be improved through dental record retrieval at Brooks Air Force Base, funded by NIDR.

THE FUTURE

Results so far have not indicated large differences in health, mortality or adverse reproductive outcomes in the two groups. However, continued follow-up is necessary to determine whether long-term effects will become evident. Some associations have been found between dioxin and measures of endocrine, immune, cardiovascular and neurological function in Ranch Hands, which, although clinically nonsignificant, are sometimes statistically significant. Continued study of these two groups will provide the best and only opportunity to determine if these findings simply

reflect the relationship between health and body fat (a correlate of dioxin) or if they are caused by dioxin itself.



RANCH HAND UNIT INSIGNIA

Designed by Capt. Allen Kidd and Lt. John Hodgin in 1962, the insignia symbolized various aspects of the RANCH HAND organization. The red lettering on a yellow circle represented the unit's close association with the Republic of Vietnam, the national colors of which were red and yellow. The brown stripe across the green field depicted a defoliation swath through a forest. The silver calligraphy in the center of the stripe was the Chinese symbol for the word "purple," the code name for the first primary herbicide used by RANCH HAND in Vietnam, and the color of the scarves worn by unit members. (Cecil, Paul F. Herbicidal Warfare. New York: 1986: iv)

NOTES

1. W.A. Buckingham, Jr., *Operation Ranch Hand: the Air Force and Herbicides in Southeast Asia 1961-1971*, Washington: Office of AF History, 1982, p.1.
2. *Ibid.* p. 3-4.
3. *Ibid.* p. 4-6.
4. *Ibid.* p. 9, 200.
5. *Ibid*, p. 188-189. Intvw., Dr. E.B. Alcott, HSC/HO, with Col. W.H. Wolfe, AL/AO, 20 Apr 94.
6. Intvw., Dr. E.B. Alcott, HSC/HO, with Col. W.H. Wolfe, AL/AO, 14 Sep 94.
7. *Ibid.*
8. W.A. Buckingham, Jr., *Operation Ranch Hand: the Air Force and Herbicides in Southeast Asia 1961-1971*, Washington: Office of AF History, 1982, p.192.
9. *Ibid.*
10. Intvw., Dr. E.B. Alcott, HSC/HO, with Col. W.H. Wolfe, AL/AO, 20 Apr 94.
11. Intvw., Dr. E.B. Alcott, HSC/HO, with Col. J.C. Miner, AL/AO, 6 May 94.
12. *Ibid.*
13. Intvw., Dr. E.B. Alcott, HSC/HO, with Col. W.H. Wolfe, AL/AO, 14 Sep 94.
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16. Intvw., Dr. E.B. Alcott, HSC/HO, with Col. W.H. Wolfe, AL/AO, 14 Sep 94.
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18. Ibid.
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26. Intvw., Dr. E.B. Alcott, HSC/HO, with Col. W.H. Wolfe, AL/AO, 14 Sep 94.
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