The Tactical–Commercial Distinction: 2,4,5-T, TCDD, and the Recognition of War-Related Health Harm in the Panama Canal Zone

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KEY WORDS

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ABSTRACT

This paper examines the Panama Canal Zone as an under-recognized case of potential military-related herbicide exposure and delayed health recognition among United States veterans. The analysis focuses on 2,4,5-T and its associated contaminant 2,3,7,8-TCDD, a highly persistent dioxin linked to the manufacture of phenoxy herbicides. Rather than treating the distinction between "tactical" and "commercial" herbicides as a purely administrative category, the paper asks how this distinction has shaped the interpretation of fragmented evidence concerning contamination, exposure pathways, and veterans' health claims.

The Panama Canal Zone provides an important case for studying war-related environmental health beyond the conventional Vietnam-centered frame of Agent Orange. Herbicides used, stored, transported, or applied on and around military installations have created exposure opportunities that were not easily recognized within existing administrative classifications. This paper does not argue that classification alone proves exposure or disease causation. Instead, it examines how classification systems influence what evidence is collected, preserved, connected, or dismissed when toxic harm is delayed, dispersed, and difficult to document.

Using a historical-documentary and conceptual approach, the paper brings together toxicological knowledge, military and herbicide-use documentation, veterans' exposure claims, and institutional criteria for recognizing exposure-related health harm. The

analysis is organized around an evidence map that includes chemical evidence, administrative categories, geographic context, exposure pathways, health outcomes, and institutional response. This framework makes it possible to evaluate incomplete but converging evidence without reducing the case either to unsupported certainty or to dismissal because records are fragmented.

The paper argues that the tactical/commercial distinction may obscure toxicological and historical continuities relevant to veterans' health. In the Panama Canal Zone case, the problem is not only whether a particular substance was officially categorized as "tactical" or "commercial," but whether existing categories adequately capture the realities of military-related contamination, long-term exposure, latency, and institutional responsibility. The contribution of the paper is twofold: first, it presents the Panama Canal Zone as a significant case for War and Health research; second, it proposes a method for reconstructing fragmented evidence in cases where exposure is historically plausible, toxicologically significant, but administratively difficult to recognize.

Key points

1. The Panama Canal Zone is an under-recognized case for studying potential military-related herbicide exposure and delayed health recognition among veterans.
2. The tactical/commercial herbicide distinction may obscure exposure pathways that are relevant to toxicological assessment and public health responsibility.
3. Fragmented historical, toxicological, geographic, and institutional evidence requires an integrated framework rather than dismissal based on incomplete records alone.

Keywords

Panama Canal Zone; veterans' health; 2,4,5-T; TCDD; Agent Orange; herbicide exposure; war-related contamination; military pollution; exposure pathways; institutional responsibility

Main discussion question

How should scientific and institutional systems evaluate incomplete but converging evidence of war-related toxic exposure when historical records are fragmented and administrative classifications obscure potential health consequences?

OJS publication link To be added after submission.

1. INTRODUCTION

The Panama Canal Zone is an under-recognized case of potential military-related herbicide exposure and delayed health recognition among our United States Veterans and civilians who lived in the Panama Canal Zone.

A U.S. Veteran who served in a place where 2,4-D & 2,4,5-T herbicides were used and has a presumptive disease as outlined by the Veterans Administration (VA) can submit a claim and should be fairly adjudicated. **[1]**

However, for the Panama Canal Zone veteran, the VA does not recognize that the same herbicide used in Vietnam was also shipped and used in the Panama Canal Zone and was capable of causing the same presumptive diseases.

The unknown was the dioxin. Dioxin was an unknown which was made during the manufacturing process of 2,4,5-T. Every batch of 2,4,5-T ever made had an unknown amount of dioxin. It is the dioxin that caused the harm to the Panama Canal Zone veterans and civilians who lived there.

In 1968, a growing amount of evidence of TCDD toxicity (from animal studies showing teratogenicity, carcinogenicity, and other effects) prompted the U.S. government to put pressure on manufacturers. The goal was to reduce TCDD impurity levels in 2,4,5-T to 0.5 ppm (or lower) through better process controls (temperature, pressure, etc., during the synthesis of the precursor 2,4,5-trichlorophenol). In 1968 a new Procurement Specification was issued to the manufacturers to tone down the dioxin content to more towards 0.5 ppm.

Because of poorly controlled temperatures during production prior to 1968, dioxin was commonly being produced between 30-40 ppm per unit of herbicide or higher: A ton of the 30-40 ppm material released ~80 times more TCDD into the environment (or into exposure pathways) than a ton at the 0.5 ppm target. Even a relatively small volume of high-ppm product could dump a disproportionate load of the dioxin on the Panama Canal Zone environment, causing a cumulative environmental load. TCDD is extremely persistent (half-life in soil often years to decades; and bioaccumulates up the food chain). Pre-reduction batches added extra “legacy” dioxin on top of later, cleaner production.

2,4-D & 2,4,5-T first started shipping under this nomenclature in 1958, but was used in the Canal Zone as early as 1948 to control the hyacinth that was interfering with the Canal traffic. **[2]** Bases surrounded Gatun Lake where herbicides controlled the hyacinth. Herbicides were used regularly in Gatun Lake to control the weeds, as

shown in the Panama Canal Review of 1966. [3] Gatun Lake was our drinking, bathing, cooking and recreational water.

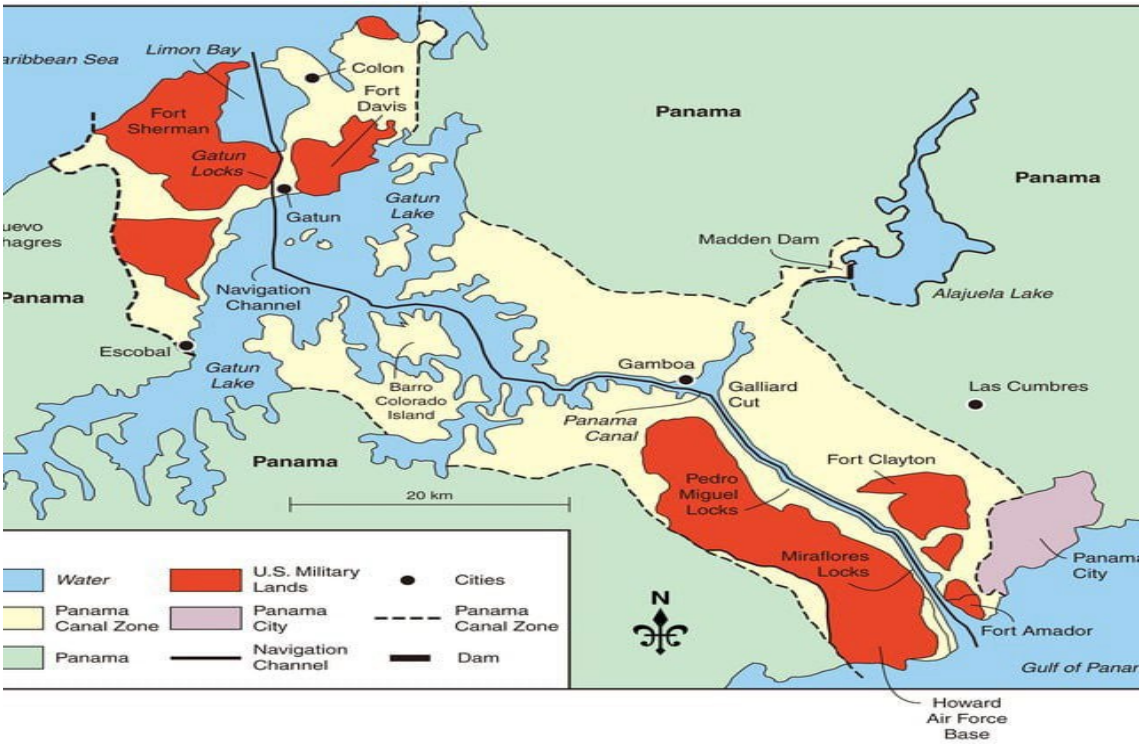


FIGURE 1. CZ MAP (Used with permission from OJSS)

Drift was a big pathway of exposure for those who lived in the Panama Canal Zone, a strip of land about 10 mile wide x 50 miles in length. By drift, this herbicide is to have been proven to drift 35 miles. [4] There were 14 bases in the Canal Zone and all had weeds that needed to be treated with a weed killer such as was available in the Canal Zone, 2,4-D & 2,4,5-T. Human contact by inhalation, dermal contact, ingestion of residues on food/water, and long-term bioaccumulation was all very possible living within the Canal Zone**.**

The U.S. Commerce exports, from 1948-1958 show this same herbicide was called weed killer. 1958-1965 it was shipped as 2,4-D & 2,4,5-T herbicide and was considered Agent Purple because of the higher dioxin content. In 1965, it was said to have been known as Agent Orange because the ester was changed. And by 1968, the manufacturers were asked to tone down the dioxin, which is the cause of disease in our veterans. Between 1958-1977, 1,500,000+ pounds of 2,4-D & 2,4,5-T was shipped and used in Panama. All of it would have disembarked within the docks of the Panama Canal Zone and then trucked to the appropriate location.

Living within the area of drift of any given base, the plausibility of being exposed without ones' knowledge by inhalation is very high. The half-life of dioxin varies depending on site conditions. In surface soil the half-life is between 1 and 3 years when fully exposed to sunlight. In an aerobic soil the half-life is between 11 and 15 years and estimated to be 20 to 50 years or more when buried in the tropical anaerobic soil. In waterways and lake sediments the half-life can be more than 100 years.

2. VIETNAM VERSUS PANAMA USE

Dioxin in 2,4-D & 2,4,5-T is what has been connected for our Vietnam veterans as causing their cancers and other serious diseases. Only the 2,4,5-T half of this herbicide is the dioxin carrier.

Both the "tactical" and the "commercial" products contained 2,4,5-T, then only two things matter:

1. **How much 2,4,5-T per gallon** - Agent Orange had ~4.2–4.4 lb of 2,4,5-T acid equivalent per gallon. A commercial 50/50 mix at 4 lb total acid equivalent per gallon would have only about 2 lb of 2,4,5-T per gallon — roughly half as much 2,4,5-T as Orange, before TCDD concentration is even considered.
2. **Most important is the second question**: How dirty that 2,4,5-T was (ppm TCDD)? This negates the 8.6 vs 4–6 difference.

Commercial 2,4,5-T was also all over the map:

- Early 1950s–early 1960s technical 2,4,5-T could be tens of ppm TCDD
- After process changes in 1968, commercial material often dropped to well under 1 ppm, and by the mid-1970s U.S. commercial specs aimed for ≤0.05 ppm, same as "Agent Orange" was said to have been.

However, tons of 2,4-D & 2,4,5-T with much higher dioxin content were already shipped by the time the new standard came about in 1968. One firm had to stop making 2,4,5-T as their batches were testing much much higher than 30-50 ppm and they could not meet the new requirement. If tactical herbicides with a different formulation and higher levels of TCDD were used instead of commercial herbicides in the Panama Canal Zone, the amount of TCDD applied to the landscape could have been increased by as much as 3000 times and would have contributed to even higher TCDD levels in the Panama Canal Zone soils and water. **[5]**

What does that mean about the difference between "tactical" and "commercial" 2,4,5-T, which is preventing our Panama Canal Zone veterans from getting fairly adjudicated by the Veterans Administration?

TCDD per gallon can be similar, somewhat lower, or even higher than Orange, depending on the lot.

The year of the manufacture of 2,4,5-T can change TCDD by 10x to 100x. That dwarfs the concentration difference between what was used in Vietnam and what was used in the Panama Canal Zone.

Bottom line: 8-6 lb/gal vs 4–6 lb/gal does not mean "about twice the dioxin."

If the commercial product was a 2,4,5-T brush killer from the same era, dioxin per gallon could be in the same ballpark; the bigger unknowns are how much 2,4,5-T was in that formulation, which year's production it was, and how much was applied?

The difference was the way 2,4-D & 2,4,5-T was used in Vietnam versus the Panama Canal Zone.

Diluting it for weed control does not automatically make it less serious for people who lived and recreated there. Concentration in the tank is only one piece. Where it landed, how often, and how long people stayed in the area can matter more.

If the mix contained 2,4,5-T, the dioxin was still in the droplets. To kill tropical weeds, crews often sprayed more volume, more often, or both. Total 2,4,5-T (and TCDD) on an acre over a year can still be large even if each tank mix was "diluted."

3. LIVING AREAS CHANGED THE EXPOSURE MATH

Vietnam aerial Orange was usually a high, short-term load on jungle or perimeters. People were not supposed to be living on the spray grid every day.

Base weed control is the opposite pattern:

- Around quarters, roads, parade fields, offices, playgrounds, fence lines
- Truck and backpack spraying that veterans describe as routine
- Kids, families, off-duty troops on the same grass and dirt
- Skin contact, dust, tracked-in soil, runoff toward ditches and water
- Weed control in Gatun Lake

That is lower concentration × many repeats × close daily contact for a persistent chemical, that can rival or exceed a one-time high spray that you walk out of.

TCDD stays.

The herbicide itself breaks down. TCDD binds to soil. Repeated "diluted" spraying can stack dioxin in the same yards and roadsides. Later recreation contact with residue, not only with the wet spray can happen.

In the Canal Zone, runoff toward lakes and canals (including drinking-water sources) was a real pathway. Drift from truck spray is also not confined to the weed strip. People did not have to be standing in the nozzle stream to get contact.

A weaker "commercial" mix on a place where families lived for years can deliver more contact than a stronger mix on jungle you passed through in Vietnam. That is why the official "commercial, therefore not like Agent Orange" line is a weak exposure argument for people who slept, played, and worked on the sprayed ground.

4. HOW DID 2,4-D & 2,4,5-T GET TO PANAMA AND WHY?

2,4-D & 2,4,5-T was shipped and used in the Panama Canal Zone before, during and after Vietnam. As early as 1948, 2,4-D was used in Gatun Lake to destroy the hyacinth which was interfering with Canal traffic. According to the Pesticide Review who tracked sales and exports of this herbicide, Technical 2,4-d & 2,4,5-T was shipped and used in the Panama Canal Zone. **[6]**

2,4-D & 2,4,5-T was a wonderful weed killer. According to the Cropland Manuals, **[7]** it was used on front lawns, parade fields, firing ranges, and we know in Gatun Lake, our drinking water, to kill the hyacinth.

We had 14 bases in a 10 x 50 mile area in the Panama Canal Zone and many Forever Chemicals were used there to control the weeds and the insects. And to be fair, we could not have lived there comfortably without the aid of these Forever chemicals.

But it did happen! Many veterans and their families who lived there suffer tremendously with no recognition from the VA based on the belief that there is a distinction between the commercial and tactical brand and we were all exposed to the commercial brand and, therefore, according to their expert, no harm could be caused because of a supposedly n-butyl ester distinction.

5. HOW DID THE VA COME TO DISTINGUISH "COMMERCIAL" HERBICIDES FROM "TACTICAL" ONES – AND WHY DOES THAT DISTINCTION CONTINUE TO DENY FAIR ADJUDICATION FOR PANAMA CANAL ZONE VETERANS?

Vietnam veterans who spent even a brief period in-country and later developed a presumptive disease linked to herbicide exposure are routinely granted service connection. Panama Canal Zone veterans who lived and worked for years amid documented use of the same dioxin-contaminated herbicides—2,4-D and 2,4,5-T—face a far higher evidentiary bar. My husband, for example, lived with daily exposure for three years. It took a decade of appeals before the VA finally awarded benefits. No veteran should have to fight that long to prove harm from chemicals already recognized as causative in Vietnam cases.

The VA's principal rationale for this disparity rests on an expert assertion that the "commercial" formulations used in Panama lacked the n-butyl ester found in the "tactical" Agent Orange shipped to Vietnam, and therefore could not have produced the same toxic effects. That claim is factually incorrect and scientifically irrelevant. Esters affect how a herbicide adheres to or spreads across vegetation; they are not the agents of harm. The health consequences associated with these compounds stem from dioxin contamination, as established by the Stellman studies and decades of subsequent research. The VA's reliance on the presence or absence of a particular ester as a decisive distinction therefore misstates both chemistry and toxicology. Multiple primary sources demonstrate that the herbicides shipped to and used in the Panama Canal Zone were the same chemical products—containing n-butyl esters and the same potential for dioxin contamination—as those later labeled "Agent Orange":

- FT 410 shipping records showing millions of pounds of technical 2,4-D and 2,4,5-T exported to both Panama and Vietnam. (Records can be found at Hathitrust.org. Panama shipments have been compiled on the website agentorangeinpanama.com)
- Cropland manuals describing operational use of 2,4-D and 2,4,5-T on military bases.
- Pesticide review documents confirming continuous exports of these herbicides to both locations across decades. **[8]**
- FM 3-3 (1971) **[9]**, which treats 2,4-D and 2,4,5-T tactical Orange as commercially produced herbicide that could be employed tactically—not as a separate "tactical-only" formulation.
- U.S. Census Schedule B classifications (1958–1965, Group 82080; 1965–1977,

5120620) listing n-butyl ester in the exported batches. **[10]**

- Military specification MIL-H-51148 **[11]** and civilian specification O-H-210A **[12]**, both identifying n-butyl ester as the standard form of 2,4,5-T.
- Aberdeen Proving Ground Pesticide Monitoring Special Study No. 44-0102-77 (December 1976), **[13]** which detected 2,4-D, 2,4,5-T, silvex, and numerous other persistent chemicals in soils at Fort Davis and other Canal Zone sites.
- 1980 congressional hearing **[14]** testimony by Alvin Young stating that the material later called Agent Orange was commercially manufactured; the orange stripe on the drums was a logistical marking to prevent mixing with Agent White, not an indicator of a unique military formulation. Young further noted that dioxin itself was not widely recognized until approximately 1969—after large quantities of these herbicides had already been used in the Canal Zone.

While stationed at Fort Davis (1974–1977), we routinely drove the roads between bases, beaches, and jungle areas. Spray trucks treating roadside vegetation regularly enveloped trailing vehicles—including our open jeep—in chemical mist. The Aberdeen study later confirmed the presence of 2,4-D, 2,4,5-T, and related contaminants in the very locations where we lived and traveled.

The VA expert's written distinction between "tactical" and "commercial" versions is contradicted by his own congressional testimony and by the documentary record. Both the military and civilian specifications required n-butyl ester; both products carried the same risk of dioxin contamination. Treating Panama veterans as categorically different from Vietnam veterans on the basis of an inaccurate chemical distinction is neither scientifically sound nor equitable. The evidence of shipment, use, and residual contamination in the Canal Zone is extensive. Panama veterans presenting with recognized presumptive conditions and documentation of exposure to these same herbicides should receive the same presumptive consideration already afforded Vietnam veterans.

6. THE ADMINISTRATIVE CATEGORY SHAPES THE LIVES OF THOUSANDS

So the question is: Why are Panama Canal Zone veterans treated differently?

As we see in this VA's expert's own testimony in the 1980 hearing, there was no difference in what the contents were between that with an orange stripe and that which was delivered and used in the Panama Canal Zone. The Orange stripe was used only for logistical purposes for that which was delivered to Vietnam. The herbicide

coined Agent Orange shipped from the East Coast, came through the Panama Canal. That which was ordered by the base commanders for use in the Panama Canal Zone was dropped off either on the Atlantic side at Cristobal or on the Pacific side at Fort Clayton, and then trucked to the final destination.

According to the Military Specifications and the Commercial Specifications, both had this same n-butyl ester. The n-butyl ester was the standard in the commercial 2,4,5-T and was used worldwide, including the Panama Canal Zone. But, again, the esters are not important in the harm caused our veterans, but is used as the distinction between the two to cause harm for the fair adjudication of our veterans for their presumptive illnesses.

Herbicide Orange was a standard weed killer used by the Military as written in the 1970 Alvin Young report. **[15]** It was also a commercial herbicide used tactically in war and used commercially on the bases of the Panama Canal Zone. It was never a "tactical" herbicide used only in Vietnam.

In Alvin Young's 1978 report, **[16]** he claims that the Rainbows were shipped and tracked by the Pesticide Review prior to 1970. The Pesticide Review states that Technical 2,4-D & 2,4,5-T is as shown on the U.S. Commerce Exports Schedule B, under Commodity Schedule 82080 (purple) and later 5120620 (Orange), which is what we see shipped also to Panama. **[17]**

The Schedule B U.S. Commerce records show over 1,500,000 pounds of Technical herbicide 2,4-D & 2,4,5-T shipped and used in Panama throughout the decades. All would have been unloaded in the Panama Canal Zone, either on the Atlantic at Cristobal or on the Pacific at Ft. Clayton, and then trucked to their final destination.

The VA has seen a number of Panama Canal Zone veterans who have submitted claims. Some have even won at the Board of Appeals. The Board of Appeals and the VA are in disagreement about what this use of this technical 2,4-D & 2,4,5-T means for our Panama Canal veterans. This distinction written by the VA's expert is incorrect.

7. FRAGMENTED EVIDENCE

We have been told that spray records do not exist. They were destroyed after 2 years. We do know from the historical U.S. Commerce records that Technical 2,4-D & 2,4,5-T was shipped almost each month (except during some Vietnam years) and off-loaded in the Panama Canal Zone. These U.S. Commerce records can be found at Hathitrust.com and have been compiled and posted on agentorangeinpanama.com. The U.S. Commerce Schedule B Notes section tells us commodities are used in the country of destination.

From1948-1964, we know that the dioxin content was quite a bit higher, perhaps 100x as high. No testing of the batches can be found during this period. We can only go by scant scientific records saying that Agent Purple, made before Agent Orange had a much higher dioxin content and was shipped and used in the Panama Canal Zone.

Panama Canal Zone veterans who served honorably but cannot prove their illness was caused by herbicides used on base due to the fact that the government chose to delete spray records and believe there is a difference in what caused the damage. The veteran who can prove these herbicides were there and they have a presumptive disease should be fairly adjudicated, but instead, are ignored due to this erroneous distinction which matters not at all and is not even true, as we see both the so-called tactical/military and commercial 2,4-D & 2,4,5-T was exactly the same dioxin, contained the n-butyl ester the VA expert claimed was the difference. Both were exactly the same, depending on the year, the manufacturer and the completely unknown….the extent of how dirty the dioxin was in that batch.

A series of reports about the use of Agent Orange, or rather the lack of use, was written about Thailand, Guam, Okinawa, etc. A report for the VA on Panama was also written about what was used in the Panama Canal Zone. **[18]** The author claimed that veterans just don't understand the difference and yet by his own reporting and testimonies there is no difference in the dioxin content. And it is the dioxin which connects our veterans to presumptive diseases.

Dioxin was not even known to exist until 1969, by then it had already been used in the Panama Canal Zone since 1948, with no knowledge of how dirty the dioxin content of what was sprayed around our living area.

The historical evidence shows that the Panama Canal Zone veterans were not only exposed to this very same herbicide used in Vietnam, but could more likely than not have been exposed to a higher dose, due to the proximity of the spraying to and longevity to where they lived, worked and recreated.

A few Panama Canal Zone veterans have won for herbicide exposure while serving in the Panama Canal Zone and their stories can be seen on youtube @travelsoforange.

- Robert M. Navy veteran, on a Navy detail was delivered a truck full of this herbicide to spray around their communication towers – won 100%
- Michael L. Army veteran… was homeless, won 100% and passed away within a few months
- Bob T., who carried the drums by truck from the docks to bases won 100%
  Cliff M. won 100% and was able to live to see it before passing away

- Gene T. won100% after waiting 10 years
- Frank C. won for PTSD after being directly sprayed and growing a sarcoma on his face, his story can be seen here.

Several others have won for herbicide exposure while serving in the Panama Canal Zone. Unfortunately, it is difficult for Panama Canal Zone veterans to find help from their local VSO, and other free services. Panama Canal Zone is an unrecognized place of these herbicides having been shipped and used there all because of this erroneous distinction and the refusal of the VA to seriously consider the overwhelming evidence brought forward.

I encourage all those Canal Zone veterans and their family members who have a disease they think may have been caused from living in the Canal Zone to participate in an unofficial study at agentorangeinpanama.com here SCIENTIFIC STUDY – Agent Orange in Panama.

8. CONCLUSION; THE NEED FOR AN OFFICIAL STUDY OF THE HUMAN DAMAGE CAUSED OUR PANAMA CANAL ZONE VETERANS AND THEIR FAMILIES IS GREATLY NEEDED

As we see from the scant historical evidence found, we now know that our Panama Canal Zone veterans and their families were more likely than not exposed to the same or higher dioxin content and is very plausible that is the cause of so many ridden with presumptive diseases such as cancers, diabetes, heart disease and even many with a special blood cancer which has not yet been officially discovered.

We have families who lived there, swam in the waters, played in the dirt and also are ridden with the same presumptive disease that the Stellman study has connected as the cause of these presumptive diseases to our Vietnam veterans.

Some of the Panama veterans' offspring have also been affected by diabetes, cancers, and other presumptive diseases.

What can we prove? We have to go by the expert's knowledge and testimony and writings. Dr. Alvin Young testified to congress Agent Orange was "coined" orange for the painted stripe. The stripe was necessary for that which went on to Vietnam so that Agent Orange and Agent White were not mixed and clog the sprayers. That Orange was made commercially.

- We know that coming in close proximity with spraying during and after the spray, bringing in dirt from the sprayed areas, eating food where these chemicals bioaccumulated in our bodies has brought diseases we

do not comprehend.

- We can prove we could have been exposed to this vegetation management tool by the historical official Export records and what Dr. Wayne Dwernychuk **[19]** wrote during the writing of my book The Travels of Orange and other toxins about the Technical 2,4-D & 2,4,5-T shown shipped on the U.S. Commerce records to Panama:

"Toxic chemicals referred to here may have been a 50/50 mixture of the herbicides 2,4-D & 2,4,5-T, otherwise commonly known as Agent Orange (AO), and/or 2,4,5-T in isolation from other herbicides. The term "Orange Herbicide" as labelled by the U.S. military, was a 50/50 formulation of 2,4-D & 2,4,5-T to definite specifications of the US military. During manufacture of 2,4,5-T, the toxic chemical 2,37,8-tetrachlorodibenzo-p-dioxin (TCDD) in 2,4,5-T was known as a by-product of the 2,4,5-T manufacturing process back to the mid 1960's. Herbicides were also used for perimeter spraying and reducing vegetation along right of ways and roadsides in the PCZ.

"Table 2 titled Schedule B Commodity by Country Domestic/Merchandise (http://catalog.hathitrust.org/Record /000497548) clearly shows the transport and exportation of the herbicides 2,4-D & 2,4,5-T to Panama 1973-1977. It is unclear whether these two herbicides were, in fact, in an Agent Orange composition (as defined by military specifications) as a shipping commodity, or they were shipped separately. However, with respect to toxicological properties, it makes no matter whether these two herbicides were mixed or not. The very fact that 2,4,5-T was used is sufficient grounds to conclude that TCDD was applied wherever 2,4,5-T was used as a vegetation control agent. The TCDD content of the 2,4,5-T varied over time, but regardless, it was present in this herbicide and was introduced to the PCZ environment. Unfortunately, for service personnel, there were no attempts, to my knowledge, to ascertain the TCDD content of 2,4,5-T used in the PCZ or, for that matter, in PCZ soils or any other environmental media. TCDD in soil can remain a toxic component of the environment for over 100 years (Paustenbach, et al. 1992)."

- Many veterans and their families have responded to my unofficial study on Panama Canal Zone diseases. **[20]** The diseases reporting are the same and more that have not yet been reported upon by the Stellman study connecting diseases caused by dioxin.
- We know that Aberdeen came to Panama Canal Zone and tested for dioxin and many other Forever chemicals in the Canal Zone and found

many that have since been connected to the cause of diseases.

- We all saw spraying going on regularly in the Canal Zone. We know when DDT was sprayed in our neighborhoods, the truck said DDT on the side; so we all assumed that is what they were spraying in the neighborhoods.
- We have pictures from the Panama Canal Review of the DDT truck being sprayed in the neighborhoods, being sprayed from boats in Gatun Lake, and have pictures of herbicides being sprayed in and around Gatun Lake.
- We know the Non-Cropland Manual says how to use 2,4-D & 2,4,5-T and on what kind of vegetation. It says to use on the sides of roadways. We saw spraying daily on the sides of the roadways throughout the canal zone roadways. It says to use on lawns to kill the broadleaf grasses. It says to use on parade fields, firing ranges, recreational sites.
- We have found old Agent Orange barrels with the stripe in the Canal Zone and have testimony of barrels with the orange stripe sent to the Panama Canal Zone in 1968 by Charles Bartlett, a U.S. government employee.
- We have the herbicide used in the Panama Canal Zone that are known by the Stellman Study to be the cause of presumptive diseases which many who served and lived in the Panama Canal Zone now have, and yet, this administrative distinction between "tactical" and "commercial" herbicide is used to deny justice, when there is no difference between the two as far as what causes the damage…the unknown amount of dioxin in every batch ever made.
- The U.S. Commerce Exports Notes tells us that commodities were used in the country of destination.
- The Pesticide Review tells us that Technical 2,4-D & 2,4,5-T always shipped together and shipped on the U.S. Exports.

What standards of evidence should govern claims of military-related toxic exposure when the exposure is historically plausible, toxicologically significant, and yet administratively difficult to document with incomplete records?

38 U.S.C. § 1116 and 38 C.F.R. § 3.307 do not distinguish between "tactical" and "commercial" herbicides. They name specific chemicals—2,4-D, 2,4,5-T and its associated TCDD contaminant, cacodylic acid, and picloram—used in support of military operations in Vietnam and in certain later-designated locations. More than two million pounds of herbicides were shipped to and used in Panama, including approximately 1.5 million pounds of technical-grade 2,4-D and 2,4,5-T—the same

active ingredients employed in Vietnam. The ester formulations themselves did not produce the primary toxic effects; the active ingredients and the TCDD contaminant did. Yet the distinction between "tactical" and "commercial" formulations has been invoked—most notably in the October 2013 report Investigations into Tactical and Commercial Herbicides (Agent Orange Investigative Report Series, No. 12), prepared under contract for the Department of Veterans Affairs—to deny benefits to veterans who served honorably.

The absence of complete spray records must not be treated as proof of non-exposure. When historical shipping records, contemporaneous use patterns, and toxicological evidence converge, a robust epidemiological study of those who lived and served in the Panama Canal Zone is both scientifically warranted and long overdue.

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