

Who Was Exposed to Agent Orange? Probably No-one

Before you and your children and grandchildren could suffer any disease, disorder, disability, defect or death from Agent Orange you had to have been exposed to the dioxin in Agent Orange over sufficient time to absorb, inhale or ingest the dioxin, and in sufficient dosage to have any effect at all.

(Actually the science does not support the claim that if you were exposed, you and your progeny would have suffered those conditions. But let's put that aside for the moment, and just examine exposure).

So when were you there? How were you exposed?

All Agent Orange spraying stopped in Phuoc Tuy province in June 1968. So no-one was directly sprayed after that date in Phuoc Tuy province. When were you there?

Ted Brooker RNZAC flew with 161 Recce Flight in 1 ATF from July 1968 to February 1969. He reports that he flew as the Forward Air Controller (FAC) with the only Agent Orange mission in Phuoc Tuy during that time. His logbook is a bit disordered but it was either 23 September or 9 October 1968. He also reports that there were no friendlies in the flight path, that they were "many miles away".

The June 1968 date above is taken from the HERBS Tapes, the computerised record of all USAF herbicide missions, and is accurate for all missions that originated in Phuoc Tuy. There were about two missions after June 1968 that originated outside Phuoc Tuy but crossed the provincial border. Ted's mission may have been one of those.

President Nixon ordered a halt to all Agent Orange missions in all of Vietnam in May 1970, about the time that V5 Company arrived. So no-one was directly sprayed in any other province after that date. When were you there?

Agent Orange was not sprayed over the Nui Dat and Horseshoe bases. Those of you who report spraying from C123 aircraft over Nui Dat and the Horseshoe are confusing Operation RANCH HAND (defoliation) with Operation FLYSWATTER (anti-malarial). It was anti-malarial.

You were sprayed with the harmless anti-malarial Malathion.

And no, you weren't sprayed with Agent Orange in those Fire Support Bases either.

If you noticed a film on your coffee after the spraying, that was from the creamer or milk in your coffee (i.e. the fat).

If you noticed the leaves on the rubber trees in Nui Dat falling off that was because rubber tree leaves fall off every year and grow back again every year.

And no, you didn't spray Agent Orange from that backpack sprayer. It was commercial herbicide and didn't contain dioxin. And no, Agent Orange was not stored at Nui Dat and Vung Tau.

Operation FLYSWATTER aircraft also conducted anti-malarial spraying in some operational areas near towns and villages, and also in areas where there were known to be numbers of VC, and where allied troops were operating (e.g. The Long Green). If you were told on operations that it was anti-malarial, it was anti-malarial.

If you really really did take a cool shower in the spray, you were making doubly sure the mosquito didn't get you.

Malaria caused many more casualties than the VC and NVA. And the reduction in fighting strength by the mosquito was a serious problem. For instance, late in 1968 in Nui Dat, in a two battalion task force, the fighting strength of a battalion was laid low by malaria. The war against the mosquito was as high a priority as the war against the VC and NVA. That's why there were so many Operation FLYSWATTER missions especially during the malaria season. They weren't Agent Orange.

Even if you were in Vietnam when defoliants were sprayed there were no friendly troops in the Agent Orange spray path.

Before any defoliation or Agent Orange spraying mission was flown, ground clearance was obtained from HQ 1st Australian Task Force to ensure that no friendly troops were operating in the area to be sprayed. That applied wherever Australian and New Zealand troops were operating, whether in Phuoc Tuy or in any other province. You were not in the spray path. That can be verified in the 1 ATF duty officer logs at the Australian War Museum.

The spraying aircraft were always shepherded by an airborne Forward Air Controller (FAC), and by ground support jets flying top cover. The slow low flying RANCH HAND planes were regularly shot at and the FAC and supporting jets needed to know that there were no friendly troops underneath so they could retaliate with cannon, rockets and bombs. They did. Often. Those RANCH HAND planes were full of patched bullet holes, and the crews were among the most highly decorated in the Vietnam war.

You were definitely not in the spray path, or anywhere near it. The computerised spray records (USAF HERBS Tapes) confirm that you were not in the spray path, or anywhere near it.

If you thought you saw trees that had been killed and turned into dust by Agent Orange, you need to know that Agent Orange was a *defoliant* that killed the leaves not the trees. Then the trees got new leaves in the next growing season. And they would sometimes be sprayed again. Napalm killed trees.

Now. About the claim of indirect exposure to dioxin in the dust, soil, water and food. The claim that you ingested, inhaled or absorbed dioxin from the environment. That claim has never been verified. It is pure speculation. There is no evidence. You were not indirectly exposed.

Later in this paper I will explain just how much dioxin there might (or might not) have been in the dust, soil, water and food in the areas you operated in. Do you realise that there was only about 1 teaspoon of dioxin in a 1,000 gallon planeload of Agent Orange, spread over an area of about 1,200,000 square metres? How much of it was in the few square metres you passed through?

And by the time you got there most of it was gone. Not that there was much in the first place.

So you didn't get indirectly exposed either. In fact you would eat a whole lot more dioxin in a Ben and Jerry ice cream without harmful effect. See later.

That's pretty much what the rest of this paper is about. You weren't exposed.

The Ukrainian former president Viktor Yushchenko really was exposed before he became president. He was poisoned with about a teaspoon of dioxin, all to himself. He was very sick for a while but he's alive and well today and showing no ill effects. We'll meet him later.

The Prevailing Exposure Assumption in New Zealand

New Zealand claim maker Victor Johnson has consistently and persistently made this statement for over thirty years as one of the two premises¹ that form the basis of his version of the Agent Orange claim making narrative:

“Research I performed during 1984 and 1985 determined to my satisfaction that New Zealand troops operated in defoliated areas within Phuoc Tuy Province. The information is in the document titled as, 'New Zealand Military Forces Likely to Have Been Exposed to Chemicals in South Vietnam', authored by Victor R Johnson. The document was lodged with the Alexander Turnbull Library, New Zealand Pacific Region, in 1985.

¹ The other being that New Zealand Vietnam veterans have died and have suffered health conditions at a greater incidence than veterans of other wars, and at a greater incidence than the general population.

“The document has been known within the parliamentary circles, especially through the former Napier member of parliament, the late Mr Geoff Braybrooke. Mr Braybrooke was sent the topographical map and HERB records used to plot flight spray missions over Phuoc Tuy Province. The map has never been returned and was unable to be found when its return was requested.”²

“Approximately 3400 New Zealanders served in Vietnam and my research establishes that about 2400 personnel would most likely have been the most heavily exposed to defoliants”.³

“... most likely” and “most heavily exposed” are assumptions amounting to pure speculation. There is no evidence to support the speculation.

The basic claim making premise is that because a large volume of herbicide was sprayed over a large area of South Vietnam in which soldiers lived and operated, then all soldiers, or all combat soldiers, were exposed to the dioxin contaminant of one of the herbicides, and in sufficient dosage (dose response) over sufficient time (time exposure) to cause delayed deaths, diseases and disorders in the war veterans, and reproductive defects and disorders in their progeny.

In Johnson’s case it is that because a large volume of herbicide was sprayed over Phuoc Tuy province where New Zealand soldiers lived and operated then they were likely to have been exposed, about 2,400 of us “most likely” to have been “heavily exposed”.

The claim cannot logically stand on its own without evidence of actual exposure, and evidence of cause and effect across the wide range of claimed conditions including skin conditions, heart disease, diabetes, cancers and reproductive disorders. The fact that defoliants were used in Vietnam, and that we operated in some of those areas after the spraying, is a surrogate or substitute for exposure rather than a measurement of actual exposure.

It doesn’t prove that we were exposed. Or even that we might have been exposed.

National Academy of Sciences

The US National Academy of Sciences (NAS) has a different perspective. Its 1994 Report (NAS 1994) described in detail previous attempts to identify and quantify exposure to Agent Orange in Vietnam. It detailed in its Chapter 6⁴ a range of possible methodologies for determining exposure but concluded that insufficient data was available for any to be conclusive.

² Johnson, V., Brief of Evidence to the Waitangi Tribunal, WAI 2500, #A152, 11 March 2016, para 8.

³ Johnson, V., Full Text of International Independent Agent Orange Network (New Zealand) Document, Submission to New Zealand Government Foreign Affairs and Defence Select Committee Hearing on the Vietnam Veterans Health Inquiry Bill 1990, 4 August 1990, Part 1.0.

⁴ NAS 1994, pp 250-299

“Estimation of health risks associated with herbicide exposure consists of two primary activities: (1) exposure assessment and (2) assessment of the health effects in exposed individuals. The committee has found in its review that the weakest methodologic aspects complicating the interpretation of the available epidemiologic studies are the definition and quantification of exposure.”⁵

“When the concern is with low-level, possibly intermittent exposure to a chemical such as an herbicide, it becomes important not simply to assess exposure as its presence or absence, but to characterize the degree of exposure - its intensity and duration.”⁶

“Different approaches have been used in estimating exposure to herbicides in studies of Vietnam veterans. These studies generally rely on self-reported exposures, records-based exposure estimates, or biomarkers. Each of these approaches is limited in its ability to determine precisely the intensity and duration of individual exposure.”⁷

The existing epidemiologic data base reviewed by the committee is severely lacking in quantitative measures of individual exposure to herbicides and TCDD. Assessment of the intensity and duration of individual exposures is a key component in determining whether specific health outcomes are associated with exposure to TCDD or other chemicals found in the herbicides used in Vietnam. Although different approaches have been used to estimate exposure in Vietnam veterans and in others exposed occupationally or environmentally, each of the approaches is limited in its ability to determine precisely the degree and level of individual exposure.”⁸

In the absence of sufficient evidence to determine exposure the Committee in 1994 proceeded on the basis that service in Vietnam was a surrogate for exposure, regardless of whether or not veterans were either individually or collectively exposed.

In 2008 NAS published an assessment of a proposed exposure assessment model.

“A fundamental and persisting challenge in these studies has been to determine the amount of herbicide in the environment in Vietnam, identify military personnel who were exposed to the herbicides, distinguish them from personnel who were not exposed, and estimate the herbicide or dioxin dose that exposed individuals received.”⁹

⁵ Ibid, p 250

⁶ Ibid, p 251

⁷ Ibid, p 270

⁸ Ibid, p 290

⁹ IOM NAS Committee on Making Best Use of the Agent Orange Exposure Reconstruction Model, Board on Military and Veterans Health, The Utility of Proximity-Based Herbicide Exposure Assessment in Epidemiologic Studies of Vietnam Veterans, 2008, p 2. <http://www.nap.edu/catalog/12059.htm>

“Congress originally sought from the IOM [NAS] reviews an assessment of the increased risk that Vietnam veterans would have for conditions found to be associated with herbicide exposure. None of the review committees have been able to make quantitative assessments, in part, because credible direct or proxy measurements of Vietnam veterans’ herbicide exposure have not been available.”¹⁰

The Committee on Making Best Use of the Agent Orange Exposure Reconstruction Model, was a committee of the Board on Military and Veterans Health of the Institute of Medicine (IOM) of the National Academies of Sciences (NAS). It was established to examine an assessment model developed to try to better determine soldiers’ exposure when conducting epidemiological studies. The model was developed by Professors Jeanne and Steven Stellman.

In assessing the Stellman model the committee brought together the long duelling principal protagonists on both sides of the exposure debate; notably the Professors Stellman promoting the feasibility of measuring exposure, and opposing them Alvin Young, Michael Ginevan and John Ross. Many others were also consulted. The committee also made reference to several papers by the opposing sides. It seemed to reach a compromise between the opposing views, but settled nothing.

An Exposure Assessment Hierarchy

The committee viewed the Stellman team’s exposure assessment model in the context of an exposure assessment hierarchy for herbicide spraying in Vietnam.¹¹

- 1) At the simplest level, “exposure” is defined based on a veteran’s presence or absence in Vietnam during the period of herbicide spraying.
[This is the current presumptive standard in USA, Australia and New Zealand, except that it also includes the period after spraying stopped. We are all presumed to have been “exposed”, regardless.]
- 2) Measures of exposure at the second level are based on information on the location, timing, and volume of herbicide spraying combined with information on the location in space and time of individuals or military units.
[This involves the HERBS spray mission tapes to determine location, timing and volume, combined with the regular, sometimes hourly, unit location statements.]
- 3) At the third level, proximity-based exposure metrics might be refined by the incorporation of more detailed data or models for the fate and transport of herbicides in the environment, such as spray drift models,

¹⁰ Ibid., p 3.

¹¹ Ibid., p 5.

estimates of the proportion of the sprayed herbicide that reached the ground, or consideration of secondary transport of the herbicides or the TCDD contaminant in the environment.

[A canopy and leaf index (see later) is an example of this type of metric, although it is not universally accepted. This information is generally not available although it is sometimes presumed by claim makers.]

- 4) The fourth level of the hierarchy would require data on individual-level interactions with the environment (e.g., dermal exposure to soil, consumption of local food) to better estimate personal exposures and permit examination of differences among units or individuals present at the same places and times.
[Not available except anecdotally by individual claim makers.]
- 5) At the fifth and most highly refined level, information on pharmacokinetics would be needed to estimate the doses of a toxic compound that individuals receive.
[Not available]

The Stellman team's model operates primarily at the second level of this hierarchy, relating the location of military units in time and space to the timing, location, and volume of herbicide spraying. The evaluating committee found that understanding that aspect of the model was necessary in order to accurately evaluate its strengths and weaknesses and to advise future researchers about its appropriate use. It was not endorsed without qualification.

*“Despite the name of the committee, it is important to note that the herbicide exposure assessment model that was reviewed is not an exposure reconstruction model. To the committee, “exposure reconstruction” suggests the possibility of arriving at a retrospective estimate of the quantity of herbicide that individuals or groups were exposed to, or even the dose they might have received. Instead, the model produces metrics based on proximity to herbicide spraying that are **only surrogates for exposure.**”¹²*

In its current form, the Stellman team's model does not offer means of generating exposure scores linked specifically to TCDD. Although it is possible to calculate scores specifically for exposure to Agent Orange and the other herbicides that contained 2,4,5-T, the level of TCDD contamination in these herbicides varied over time and by several orders of magnitude (from less than 0.05 ppm to 50 ppm; IOM, 1994). Because the model incorporates no adjustments for varying levels of TCDD, the potential exists for misclassification in estimates of exposure to TCDD. This implies that the model will generally be better suited for examining exposure to herbicides than for examining exposure to TCDD.¹³

¹² Ibid., p 4.

¹³ Ibid., p 50.

This observation is relevant in the context of the New Zealand Agent Orange narrative in which imputed or alleged exposure to Agent Orange is a surrogate for actual exposure to TCDD/Dioxin.

The Final NAS Report 2014

As in previous reports the Committee detailed all of the previous methodologies and attempts to identify and quantify exposure¹⁴ but as in all previous reports was unable to do so.

“Determining the exposures of US military personnel who served in Vietnam has been perhaps the greatest challenge in the study of the health effects associated with herbicides and TCDD. Some military personnel stationed in cities or on large bases may have received little or no herbicide exposure, whereas troops who moved through defoliated areas soon after treatment may have been exposed through soil contact, drinking water, or bathing. In most cases it is not possible to make reliable estimates of the magnitude and duration of such exposures because of the lack of contemporaneous chemical measurements, the lack of a full understanding of the movement and behavior of the defoliants in the environment, and the lack of records of individual behaviors and locations. Consequently, most studies have focused on populations that had well-defined tasks that brought them into contact with the agents. It is believed that the subjects of those studies, primarily Air Force personnel involved in fixed-wing aircraft spraying activities (often referred to as Operation Ranch Hand [ORH]) and members of the US Army Chemical Corps (ACC), may have had among the highest exposures. As described below, the exposures of ground troops are difficult to define, so this group has not been studied as intensively. As illustrated by Figure 1-1 in Chapter 1, the median TCDD levels in veterans who had worked in Operation Ranch Hand were higher than those measured in their own comparison group or in ground troops, which both had median levels in the unitary ppt range of contemporaneous background levels, but about an order of magnitude less than herbicide production workers, who in turn had levels about two orders of magnitude less than individuals who resided near the site of the industrial explosion in Seveso, Italy (Pirkle et al., 1995).

“In accordance with Congress’s mandated presumption of herbicide exposure of all Vietnam veterans, VAO committees have treated Vietnam-veteran status as a proxy for some herbicide exposure when more specific exposure information is not available.”¹⁵

Despite over twenty years of research and meta-analysis the National Academy of Sciences has been unable to determine who was exposed, apart from those who mixed and stored the chemicals and those who sprayed them.

¹⁴ NAS 2014, Chapter 3, Exposure to the Herbicides used in Vietnam, pp 65-91

¹⁵ NAS 2014, pp 101 -102.

Who Was Exposed to Agent Orange and other Toxic Chemicals?

Was anyone directly sprayed?

No. It is probable that no-one was **directly** sprayed and exposed to the dioxin in Agent Orange by Operation Ranch Hand aircraft.

Data available shows that the actual aerial spraying of Agent Orange over Phuoc Tuy province was nowhere near the intensity and degree of saturation claimed in some of the evidence. Data also shows that the last actual aerial spraying of Agent Orange in Phuoc Tuy province was on 30th June 1968¹⁶ (although as Ted Brooker reports there was one later mission in September/October 1968 that probably originated outside Phuoc Tuy, and he reports that it was the only defoliation mission in Phuoc Tuy in the period from July 1968 to February 1969).

Therefore the last infantry companies that may (or may not) have been directly sprayed, or that may have operated in recently sprayed areas, were V3 Company (June 1968 to May 1969) and W1 Company (November 1967 to November 1968). Note that V3 Company spent its first few weeks on the Horseshoe. The companies that were in Vietnam up to that time represent only 45% of all the infantry companies that served in Vietnam. Nevertheless individuals who served in theatre later than June 1968 do claim to have been directly sprayed.

V5 Company arrived in theatre about the same time that President Nixon ordered a halt to the use of Agent Orange throughout all of Vietnam from May 1970. Yet some of them still claim to have been directly sprayed with Agent Orange, or to have used it in local spraying.

Veterans who arrived in Vietnam after June 1968, and who have claimed to have been sprayed with Agent Orange whilst on operations in Phuoc Tuy province “by planes overhead”, and to have operated in a mist of spray or similar recollection, are mistaken.

At all times Australian and New Zealand troops were kept out of areas about to be overflowed by air missions. That obviously applied to pre-planned bombing missions. It also applied along the flight paths of spraying aircraft to allow their airborne forward air controllers (FACs) and their fighter escorts to retaliate and suppress enemy ground fire. It was a simple command and staff procedure to establish those “free fire zones” in specified areas for specified periods.¹⁷

¹⁶ USAF Data Services, HERBS Tapes Defoliation Missions in South Vietnam 1965-1971, Phuoc Tuy Province.

¹⁷ For example, in the 1st Australian Task Force Commanders Diary for 8 January 1968 (at the Australian War Museum), at Serial 1271, the duty officer’s log records a request from 9 Division for approval to defoliate on a specific date at a specific time, and in specific areas. It was approved and clearance was given to “return fire for fire”, confirming that troops would not be in that area at that time.

If not directly sprayed what about indirect exposure?

Contrary to what many now believe, when they insist that they were directly exposed to Agent Orange, the “Agent Orange” campaign by Vietnam veterans was actually built on the premise that indirect exposure to herbicides and pesticides in Vietnam was as relevant as direct exposure. The case was made that there was a latency effect in which some of the toxic chemicals remained in the environment, affecting humans, and perhaps the food chain. Those claims are that we ingested, inhaled or absorbed dioxin from the environment.

We can assume with some confidence that soldiers in the Nui Dat base and elsewhere were not deliberately and directly sprayed with herbicides or pesticides, except for the anti-malarial Malathion which was sprayed by Operation FLYSWATTER C123 aircraft and by helicopter, over areas that were occupied by Australian and New Zealand troops.

The exception to that might be those few soldiers who were allocated herbicide and pesticide spraying duties in and around the bases, and who might have come into direct contact. However, it should be noted that tactical herbicides (i.e. the “Agents”) were not authorised to be used in bases, where commercial herbicides were used.¹⁸

As noted above there have been numerous attempts at exposure reconstruction and to develop models that could be used to determine exposures of ground troops. None has so far been scientifically successful.

The question then remains, “*Who was, or might have been, indirectly exposed to toxic chemicals, and in sufficient dosage to cause health effects?*”

The answer in relation to the dioxin in Agent Orange is probably, “*Almost no-one*”.

That would seem to be supported by the epidemiological studies that have not been able to establish a direct causal link, or any significant elevation in health conditions or mortality in Vietnam veterans, their children and grandchildren, compared to the general population.

The Dioxin in Agent Orange: Was the threshold dosage reached?

How much dioxin might the Vietnam veteran have been exposed to, assuming for the moment that New Zealand veterans might have been exposed, if only indirectly.

Notwithstanding my conclusion that almost no-one “*was, or might have been, indirectly exposed to toxic chemicals, and in sufficient dosage to cause health effects*” research to determine the likely dosage if soldiers

¹⁸ Young, Alvin & F Cecil, Paul. (2011). Agent Orange Exposure and Attributed Health Effects in Vietnam Veterans. *Military medicine*. 176. 29-34. 10.7205/MILMED-D-11-00082.

were indirectly exposed would be helpful. The following analysis is based on evidence that the mean level of dioxin in Agent Orange was 13 parts per million¹⁹.

Agent Orange and Dioxin

** First and most importantly it should be recognised that Agent Orange is not synonymous with the toxic TCDD or dioxin. It is not the same thing. **

Agent Orange was a 50/50 mix of two systemic broadleaf herbicides, 2,4,D and 2,4,5,T. During the manufacturing process of 2,4,5,T a contaminant called Dioxin or TCDD was formed. Dioxin itself did not affect plants or plant growth. The amount of dioxin in 2,4,5,T varied slightly with the manufacturer as proper temperature controls and the role of dioxin was not completely understood.

It seems that many have assumed that 1,000 gallons of Agent Orange equals 1,000 gallons of dioxin, the toxic component of Agent Orange. That is not the case, for dioxin was a minute component of Agent Orange, a by-product of the manufacture of 2,4,5-T.

Estimates of the amount of dioxin in the herbicides vary because each manufacturer and each batch of 2,4,5-T had different levels of the dioxin contaminant. Different batches from different manufacturers were sometimes mixed. However the dioxin content, based on samples of Agent Orange tested in 1977, ranged from less than 3 parts per million to about 50 parts per million (ppm).

How much dioxin was there in a planeload of Agent Orange?

At the higher end (50 ppm) the dioxin in Agent Orange would equate to 0.005%. That would then equate to 0.05 gallons of dioxin (less than 0.2 litres or just under 40 teaspoons) in every 1,000 gallon planeload of Agent Orange, spread over a spray area of approximately 120 hectares or 1.2 square kilometres, or 1,200,000 square metres (even more if drift is taken into account).

At the lower end (3 ppm) the dioxin would equate to just 0.0003%. That would then equate to 0.003 gallons of dioxin (just over 1 millilitre or 1/5th of a teaspoon) in every 1,000 gallon planeload of Agent Orange spread over a spray area of 120 hectares or 1.2 square kilometres, or 1,200,000 square metres.

At 15 ppm the dioxin in a planeload of Agent Orange would amount to 1 teaspoon. That is 1 teaspoon in every 1,000 gallon planeload of Agent Orange spread over a spray area of 120 hectares or 1.2 square kilometres, or 1,200,000 square metres.

Estimates of dioxin contamination in Agent Orange from the 1970s onwards have varied over time from as low as 0.05 ppm up to 50 ppm.

¹⁹ NAS 2014, p 70.

Research in 2008 concluded that the mean dioxin concentration in Agent Orange was closer to 13 ppm than to the earlier estimates, meaning that **a 1,000 gallon planeload of Agent Orange would contain about 1 teaspoon of dioxin.**

How much dioxin actually reached the ground?

If we then take into consideration a jungle canopy and leaf area index, the research indicates that less than about 6% of the total aerial spray would reach the undergrowth and jungle floor. That is, more than 94% of the spray would settle on and stick to the leaves in the canopy and not reach the undergrowth and jungle floor. Even at the higher level of dioxin in Agent Orange (50 ppm), only 0.003 gallons (just over 1 millilitre or 1/5th of a teaspoon) of dioxin would reach the undergrowth and jungle floor, spread over an area of 120 hectares or 1.2 square kilometres, or 1,200,000 square metres.

At the mean level of dioxin in Agent Orange, say 15 ppm, then about 0.06 of a teaspoon (or about 1/16th of a teaspoon) would reach the undergrowth and jungle floor, spread over an area of 120 hectares or 1.2 square kilometres, or 1,200,000 square metres. **1/16th of a teaspoon of dioxin would have reached the ground spread over 1.2 million square metres.**

How much was in the few square metres you passed through?

How long would the dioxin stick around?

The dioxin in the canopy then immediately starts to degrade under the influence of the UV rays in sunlight. The dioxin on the jungle floor also degrades but at a lesser rate, although when the canopy is defoliated the sun will reach the jungle floor. Given that Operation Ranch Hand missions were conducted in the early mornings in rain and wind free conditions it can be assumed that they were conducted on sunny days and degradation started almost immediately.

We're talking teaspoons not gallons or litres

Those calculations are based on the best estimates of the levels of dioxin in Agent Orange, and on the approximate area sprayed in one pass of an aircraft with 1,000 gallons of Agent Orange, and a canopy and leaf index. The leaf and canopy index has been disputed by some researchers. However the relevance of the calculations diminishes when they get down to such minute quantities and small differences in percentages. But they do serve to demonstrate that we are talking in teaspoons rather than gallons or litres of dioxin, spread over a wide area.

Forget the propaganda that the whole landscape was awash in dioxin. Think teaspoons. Actually, less than one teaspoon spread over 1,200,000 square metres.

How much was there in the few square metres you passed through?

Were New Zealand Vietnam veterans really indirectly exposed?

I would suggest that the amount of dioxin present in Agent Orange, spread over a wide area, was not sufficient to reach a threshold dose causing disease, disorder, disability, defect and death in soldiers who entered defoliated areas from 8 days to 3½ years after spraying²⁰, or in their children and grandchildren.

Ben and Jerry Ice Cream

In 2000 two US researchers, Michael Gough and Stephen Milloy, sent an ice cream sample to an independent laboratory to test it for the presence of TCDD/Dioxin. It came back positive and contained 190 times more dioxin than the Virtually Safe Dose (VSD) set by the US Environmental Protection Agency.

The point of that research was not that Ben and Jerry ice cream was contaminated but that dioxin was present in the environment, most notably in cows' milk, and also in human milk. Given that dioxin was also present in herbicides used on New Zealand pastures for a lengthy period it was also present in cows' milk and human milk in New Zealand, probably in similar concentrations.

That level of dioxin in everyone's ice cream²¹ would have exceeded the level of dioxin alleged to have been present in the Vietnam landscape as a result of occasional spraying of jungle and mangrove.

Gough and Milloy themselves did not and do not subscribe to the theory that dioxin is a human carcinogen:

".. we do not believe that credible scientific evidence exists to conclude that dioxin causes cancer in humans. Studies of populations exposed to high levels of dioxin as a result of the industrial explosion at Seveso, Italy⁽¹³⁾ and participation in the U.S. Air Force Ranch Hand project during the Vietnam War (spraying Agent Orange) do not support the hypothesis that dioxin is a human carcinogen."

Viktor Yushchenko has not yet developed any cancers.

A Case Study: Viktor Yushchenko

The case involving Yushchenko is a single incident and may have no relevance to Agent Orange exposure in Vietnam, but it does illustrate that the toxicology of the dioxin contaminant in Agent Orange is not yet settled.

I previously made a comparison between a teaspoon of dioxin sprayed over an area of 1.2 million square metres in Vietnam, and what might have

²⁰ According to the research presented by NZDF to the Parliamentary Health Select Committee.

²¹ The dioxin levels in milk have reduced since dioxin was banned.

been a teaspoon of dioxin in a cup of tea or soup that Yushchenko was given.

There have been three known cases of dioxin poisoning, two women in Austria and Viktor Yushchenko:

“London, Aug 4, 2009. -- The dioxin that poisoned Ukrainian presidential candidate Viktor Yushchenko in 2004 was so pure that it was definitely made in a laboratory, a new study says.”²²

“Still, scientists can't tell where the chemical came from and who was ultimately behind the poisoning of Yushchenko, now the president of Ukraine.

“After Yushchenko fell seriously ill following a dinner in Kiev in September 2004, doctors found dioxin levels in his blood more than 50,000 times higher than normal.

“Hundreds of dioxins are produced during manufacturing processes that use chlorine, like herbicides, paper and pulp bleaching, and most people in the West have some level of dioxins naturally in their body.

“But the type of dioxin doctors found in Yushchenko, TCDD, was the most lethal kind; it was also used in Agent Orange, a herbicide sprayed by U.S. troops during the Vietnam War that has been linked to numerous health problems.

“After Yushchenko's poisoning, he suffered severe gastrointestinal problems and his face was temporarily disfigured. In a study published online Wednesday in the medical journal Lancet, Yushchenko's doctors report that it took about 15 and a half months for his body to get rid of half of the dioxin, much quicker than the years that other experts had estimated it would take.

“His doctors said that was due to the treatment they gave him, though they would not discuss exactly what they did.

“The level of (dioxin) in Yushchenko's body shows that he was deliberately poisoned,” said John Emsley, of the department of chemistry at Cambridge University. Emsley was not linked to the Lancet study.

“I cannot believe anyone would willingly take (dioxin) knowing the terrible skin condition it produces,” he said, adding it is most visible on the face, but often affects other areas, including the genitals.

“The dioxin used to poison Yushchenko could have been produced in numerous laboratories. And because it was a purified version that has no natural source -- unlike the polonium used to kill Kremlin critic Alexander Litvinenko in London in 2006 -- scientists don't have any clues to trace its origins.

²² [http://www.thelancet.com/pdfs/journals/lancet/PIIS0140-6736\(09\)61027-8.pdf](http://www.thelancet.com/pdfs/journals/lancet/PIIS0140-6736(09)61027-8.pdf)

“Doctors at the University of Geneva and the Swiss Centre for Applied Human Toxicology took blood and fat samples from Yushchenko for at least three years to track how fast his body was eliminating the chemical. Dioxin is usually stored in the body's fat and liver.

“The doctors found that about 60 percent of the dioxin eliminated from his body during that time was not metabolized. Most of the dioxin was excreted through feces, though doctors also found traces of it his blood and urine”.

Whilst I speculated that the dose ingested by Mr Yushchenko, “*might have been a teaspoon of dioxin in a cup of tea that Yushchenko was given*”, it was probably a lot smaller dose than that, but much, much greater than any dose that might have been ingested, inhaled or absorbed by a foot soldier in Vietnam, for it had an immediate and very obvious effect.

Viktor Yushchenko is alive and well today and reportedly not suffering from any serious effects of his poisoning. His face is completely clear of its chloracne disfigurement. There can probably be no direct comparison between a foot soldier in Vietnam and Mr Yushchenko, but it is a very interesting comparison.

Who was exposed to dioxin?

Viktor Yushchenko was for sure, 50,000 times more than normal. If you ate American or New Zealand ice cream in Vietnam you probably were too, but not seriously.

Seriously though, you weren't exposed.

Forget the propaganda. You weren't exposed.