

“Agent” Orange Factsheet

Background

The material shipped to Viet Nam in 55 gallon drums with an orange stripe around it was only known as “Orange” or herbicide orange until sometime in the late 1970s, when the term was coined by media personalities.

Orange was a 50:50 mixture of two broad leaf weed killers, commercially known as 2,4-D and 2,4,5-T. (A chemist would refer to these as phenoxy-acetic acid derivatives) 2,4-D was invented in 1943 and 2,4,5-T in 1948, and both were in use in agriculture long before any military use was considered. As an example, in the United States in 1961, about 40 million acres were treated with these herbicides. 2,4-D is still in commercial use and readily available. Long after the war 2,4,5-T was discontinued for a few years and when its use was again authorized, the cost of refurbishing the essential equipment for its synthesis was too high to justify its reactivation.

In chemical syntheses there are usually side reactions that produce unwanted materials, and the synthesis of 2,4,5-T results in the creation of what chemists normally call a trace level of 2,3,7,8-tetrachlorodibenzo-*p*-dioxin. (Four parts per million, that is 0.0004%) The dioxin is therefore at 2 ppm in Orange. (If you were about to begin a 2000 mile drive across the USA, 2 ppm of the trip would be the first 21 feet out of your driveway.) Dioxin is also produced as a low level byproduct by several other means, including burning wood and household trash, so it is detectable almost everywhere on earth and forms part of the background environment for everyone. . It was classified as a carcinogen on the basis of tests on guinea pigs, which turn out to be extremely sensitive to it, and hamsters, which are close relatives, can survive exposures several thousand times higher. Thus human sensitivity was not definitively established.

The tactic of using defoliant to deny cover to an enemy had been used in Malaysia in the 1940s, and was considered first by US military in the Korean War, but was only implemented in a very limited way there. Some studies of the actual methodology using planes equipped with specialized spray systems went on in the US in the late 1950s, and the offer was made to the government of South Viet Nam in 1961 to try defoliation against the Viet Cong. The offer was accepted and US personnel started flying specially equipped C-123 cargo planes and learning how to be “combat cropdusters”. The results of their work were considered to be very useful in making ambushes of troops and supply trucks on main roads much more difficult for the guerillas.

Several varieties of defoliants were used, since no one chemical affects all plants. For instance, Blue was used to destroy rice crops in communist-controlled areas.

(Interestingly enough, Orange was used in the US to kill weeds in rice fields and improve production.) However, since the bulk of defoliation was aimed at jungle areas, Orange was used in the highest overall volume, about 11 million gallons over the ten years of the program.

The great bulk of all spraying was done by the Ranch Hand unit, using the engineered delivery system of tanks, pumps, and precisely machined spray nozzles installed on the planes. The research had shown that effective spraying had to be done from fairly close to the ground and under almost ideal weather conditions, so spray missions were typically done at heights of no more than 150 feet, with clear skies and little if any wind. The majority of missions employed three planes flying in formation to cover an area of

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Using the special nozzles produced a narrow range of droplets whose fall to the ground was reasonably predictable and consistent. Using 3 gallons of liquid for each acre of ground sprayed meant that the actual amount of liquid to fall on a square foot of ground (if it were flat ground instead of leafy trees) would be no more than 0.001 ounces, basically an extremely fine mist that would hardly be felt by a human face. Mists of liquids denser than water falling from that low altitude with little or no wind cannot drift very much at all, which was the point of developing the spray techniques to be precise in the first place. (Reports of clouds of mist drifting to ships thousands of yards offshore defy two realities, first, winds blow inland, not out to sea, and second, defoliant mists are not capable of such long distance drifting.)

The mist would fall on the leaves of the jungle, and depending on whether it was single canopy, double canopy, or triple canopy jungle, no more than 30% of the spray would fall all the way to the ground, and as little as 6% might get there.

Tree leaves have thin waxy layers at their surface, with which the molecular structure of the chemicals is compatible, so the materials are rapidly absorbed into that layer. Once that occurs, rainfall on those leaves will not extract more than a tiny fraction of the absorbed chemicals. The process of damaging the leaf system starts quickly, and trees typically lost their leaves in about 4 days. The dioxin molecules are very susceptible to breakdown by sunlight and air, and by that time only a small percentage (of what started out as 0.0002%) would remain.

Spraying was not done in cities or on villages, since the purpose was to affect foliage.

That the areas selected were generally enemy controlled was confirmed in the simplest yet dramatic way possible. Large planes at 150 feet can be hit by small arms fire, and all the Ranch Hand planes were struck by VC bullets many, many times. (The record holder aircraft was retired with over 800 bullet holes in it, and is now in the Air Force museum in Dayton, OH.)

Mosquito Suppression

One major confusing factor about spraying and troop exposure needs to be clarified.

Suppression of mosquitoes in areas where US troops would operate was another mission for the Cowboys. Malathion was used for this, a very effective insecticide that has remained on the market to the present time. Spraying was done in the late afternoon and early evening, the best time to hit the mosquitoes, and was done in areas where US troops could be or were operating, and that spray was perceptible to people on the ground. Troops who saw spray planes over them and experienced some dampness were exposed to the same anti-mosquito agent they may be using in their backyards today.

One way the troops would have known if they were in an area being sprayed with defoliant would have been the suppressive gunfire from the fighter jets that flew escort for the spray planes most of the time. This was why clearance for individual defoliant spraying missions had to come from Army command, not Air Force, to safeguard against any friendly fire incidents.

The sincere belief that some veterans have that they were sprayed with Orange is almost certainly based on mosquito spray missions, since those were the missions for which there were no fighter aircraft peppering the ground with gunfire, and for which the presence of our troops in the area was permissible by the Army command for the region.

Human Exposure During The War

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What this all adds up to is that very few US soldiers could have been in areas during spraying, and even if they were, there was no way anyone could have gotten soaking wet by the spray. Rain dripping off leaves would not contain any significant amount of chemicals even if the spraying were recent, and if it were some days later, there were essentially no chemicals left in any case. Men sleeping on the ground where mist had fallen recently might have some skin contact dirt particles with adsorbed chemicals, but since the chemicals are not very water soluble, they would not migrate into the skin to any significant degree anyhow.

Therefore, even soldiers who served in areas where spraying had occurred were extremely unlikely to actually absorb any significant amount of dioxin into their bodies. The ability to test blood for dioxin has been improved over the past decades to a level of sensitivity that is incredible, down to parts per trillion. (It's an expensive test, after years of improving it and lowering cost, it still costs \$3000.) Surveys across the industrial world have established a background level of 4 to 7 parts-per-trillion in people. (On that 2000 mile drive across the country, 7 ppt would be just under one-thousandth of an inch.)

In 1988 a comparative survey was done of dioxin blood levels of 97 veterans of the Viet Nam era who had not been to the war, and 646 veterans who had been in units that operated in sprayed areas on a regular basis. Both groups displayed an average of about 4 ppt serum dioxin, which is as good a demonstration as can be had that dioxin absorbance by troops in the field was not significant.

However, some people did have very heavy exposure to Orange, of which the primary group were the 1264 men who served in Operation Ranch Hand over the ten years of its existence. They had the material spilled on them, soak into their clothing, and spray on them from bullet-perforated tanks on the planes. And at times they even drank it, as part of initiation rites of new members of the unit. One officer drank some of it during an interview with a US journalist, to demonstrate it was not poisonous.

Others who may have gotten seriously exposed would be the helicopter crews that sometimes were involved in spraying, especially if they were flying behind the dispensing aircraft and did go through the falling mist.

Studies of Exposed People

The most exposed and most easily tracked group from the war were the Ranch Hand members, often referred to as the Cowboys. They have been the subjects of a 20-yr study, using a series of extremely detailed physical examinations that ended in 2002, with interim reports being issued several times in previous years. Its final overall report was issued in late 2007. Their serum concentrations of dioxin ranged from close to normal population up to over 600 ppt, but with an average of 28 ppt even many years after their last exposure. This demonstrates that they were most definitely exposed to comparatively high amounts of the defoliants and absorbed significant amounts into their bodies.

However, people who have been exposed to really high levels of dioxin (enough to give them as much as 20,000 ppt in their blood) rapidly develop a skin condition known as chloracne, which has been observed in groups of people exposed during industrial accidents such as one that occurred in Seveso, Italy, in 1976.

In that instance a chemical plant explosion spread a cloud of chemicals, including dioxin, over a wide area, in an unknown quantity that has been estimated to be as high as 20 Kg. The total dioxin in the 11 million gallons of Orange sprayed in Viet Nam would be about 80 Kg, and that was spread over an enormously larger area, and over a 10 year period, so the relative concentration of the Seveso area was much, much

dioxin, over a wide area, in an unknown quantity that has been estimated to be as high as 20 Kg. The total dioxin in the 11 million gallons of Orange sprayed in Viet Nam would be about 80 Kg, and that was spread over an enormously larger area, and over a 10 year period, so the relative concentration of the Seveso area was much, much higher. Of the approximately 370,000 people in that area, 187 experienced chloracne, and many more others had high blood concentrations of dioxin (a median level of over 4,000 ppt), so there was no question that a large number of people had undergone heavy exposure to, and absorption of, dioxin.

The Italian government commissioned very detailed studies of the exposed population, so excellent statistics are available and many reports on different aspects of their conditions. What was observed was that:

1. no one died or experienced life-threatening illness as a result of their exposure;
2. there was no rise in spontaneous abortions among the women of the exposed population in the following three years;
3. in the over 15,000 births that took place in the next five years there was no increase in the number of congenitally deformed children;
4. no increase in overall cancer rate was detectable in the ten years following the explosion.

All this is statistically meaningful data, and it demonstrates that even among a large population of people who have absorbed very high levels of dioxin, there were no significant long-term health effects on many of the most commonly examined health concerns.

A study was done in the US of over 5000 industrial workers whose jobs involved dioxin exposure (about 13% had reported chloracne episodes, so that confirmed their absorbance of high amounts of dioxin). Over a 20 year period about one-fifth of the group died, and the incidence of cancer-related deaths was about 15% higher than for the general population. However, since in general all the people were exposed in their workplaces to numerous chemicals besides dioxin (such as asbestos and other known carcinogens), it is not possible to make any conclusions from this study about whether or not there is any association between dioxin and cancer.

In recent history, a bizarre incident took place in 2004 when someone who wished to assassinate a Ukrainian politician apparently read and believed the assorted reports of dioxin as a deadly poison, and slipped an enormous dose of it into his food. The man (Viktor Yushchenko) became very ill and his appearance changed radically as a terrible case of chloracne struck him. His blood level of dioxin was in the order of 100,000 ppt, one of the all-time record highs ever observed in a human being. However, he was never in danger of death and subsequently recovered fully.

Somehow, this makes the often quoted statement that dioxin is one of the world's most deadly poisons seem a bit questionable. If you cannot kill someone with a substance even when you try really hard, most people would not think of it as being deadly; not like some snake venoms, one tiny droplet of which in a person's blood guarantees their death in a short time.

Since no Ranch Hand member ever suffered a chloracne attack it is clear that that while they did have exposure and abnormal absorbed levels of dioxin, none of them experienced really massive exposure and absorbance. Yet they still constitute the highest exposure levels of any US personnel (or any other people in Viet Nam, then or later) in the entire war. If exposure to the herbicides had any substantial effects on anyone in Viet Nam, it is an absolute certainty that those effects would be enormously more obvious in the Ranch Hand group than anywhere else. These men, and their control group counterparts, have been subject to the longest and most thorough large group health study ever made. Their control group was other Air Force personnel who flew cargo planes in the same time frame, matched by age, etc, but who were not subject to any herbicide exposure. The study took over a year just to draw up, line by careful line, by a group of highly qualified specialists, and was performed with great

flew cargo planes in the same time frame, matched by age, etc, but who were not subject to any herbicide exposure. The study took over a year just to draw up, line by careful line, by a group of highly qualified specialists, and was performed with great rigor.

They have had 7000+ children without an undue number of birth defects occurring, their mortality rate is no different than the control group, nor are there any dramatic contrasts in health between the two groups. A few more of the Cowboys have developed Type 2 diabetes (the kind many men get as they get older) than has been observed in the control group, just enough to come into the region of statistical significance. However, those men also tend to be more overweight and consume more alcohol than their counterparts in the control group, and obesity and alcohol are known to promote diabetes in later years of life. So the question can be asked as to whether it's the dioxin in their tissues that contributes to their increased diabetes, or the result of their own lifestyle.

“Scientific” Studies of Dioxin Effects

Numerous studies other than the Ranch Hand project have been performed, with many of them leading to conclusions that exposure to Orange could or probably did lead to health issues. A close examination of most studies reveals bias or errors in their structure or interpretation of the data. For instance, a recent study was undertaken in Australia to support the idea that troops on the ground suffered from their alleged exposure to defoliants. The study was specifically focused on the fact that sailors in the Australian Navy off the coast of Viet Nam actually had higher cancer rates than the Australian ground troops who served in-country.

The researchers ended up demonstrating that if dioxin were sprayed on the surface of a pool of water, which was then processed by the kind of desalinization equipment in use by Navy ships, the concentration of dioxin in the desalinized water was several times higher than the original concentration of the salt water.

They thus concluded that sailors had a higher level of exposure to dioxin than the ground troops, explaining their higher cancer rates.

This of course neglects two somewhat obvious and critical facts: first, nobody was spraying defoliants on the ocean well offshore where the Navy ships were; and second, the intakes for the ships' desalinization process are well beneath the water line, and do not take in seawater from the surface. The fact that desalinization of contaminated water increases dioxin concentration in the product water has nothing whatsoever to do with possible risk to sailors who served on ships off the coast of Viet Nam.

These researchers initiated their study with a conclusion already in mind, which is a hallmark of bad science. And they are not untypical of other researchers on this topic, most of whom were dependent on outside funding for their research and therefore had a vested interest in keeping their studies going by reporting there were “possible” effects or “indications” of effects. The Ranch Hand study remains the dramatically largest and most rigorous study ever undertaken on the subject.

Long Term Effects in Viet Nam

Since dioxin breaks down rapidly when exposed to sunlight and moisture, the only way appreciable levels of it remain anywhere long term is if it soaks into the ground or the bottom of a body of water. The fact that areas in Viet Nam sprayed with defoliants would regrow within weeks or months and had to be resprayed demonstrated that the active ingredients would break down over relatively short time frames. (The notable exception was mangrove trees, which are particularly sensitive to defoliation and do die when sprayed repeatedly. However, the areas where once mangroves thrived could be reforested, but the government of Viet Nam has not chosen to do so.)

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There has been a great deal of publicity about the loss of forests in Viet Nam and the incidence of birth defects, cancer, and skin diseases, all supposedly due to lasting effects of dioxin in the soil. Since sprayed areas had quite limited amounts of material reach the ground in the first place, the buildup of significant concentration of dioxin in those areas is extremely unlikely. There are many deforested areas in Viet Nam, but these are due to clearcutting for lumber for export.

However, it is true that once there has been a spill of the chemicals onto ground, for instance at the air bases where it was stored and used, they will soak in and remain there long term, and may also be carried along with ground water into nearby streams and ponds. There are four "hot spots" in Viet Nam, all very limited areas located in former US airbases (Tan Son Nhut, Da Nang, Bien Hoa, Phan Rang), and there is evidence of dioxin in aquatic life and the blood of the limited number of people living close to these areas. These small "hot spots" are a legitimate concern, and their clean up should not pose great difficulty and should be a priority matter for the local government.

No real data demonstrating any overall contrasts in incidence of cancer or birth defects between the South and the North (where no spraying was ever done) have ever been published. The government in Hanoi has kept up publicity on supposed effects as part of a campaign to bring in donations from other countries and especially the US to supplement their dysfunctional "socialist" health care system. Many presentations have been made and are available on the Net today of photographs of Vietnamese children with birth defects, which are always attributed to AO exposure, whether in the North or South, whether that type of defect has ever remotely been associated with dioxin or not. A photographer could as easily visit villages and orphanages in Cambodia, where no herbicide was ever sprayed, and return with as many sad images of afflicted children.

The March of Dimes 2006 report on birth defect levels across the world show that the overall average occurrence is about 5.74% of all births. The full range of levels among the 193 countries surveyed was from 3.97% to 8.2%. Viet Nam is 102nd on the list, with an incidence of 5.51%, lower than 91 other countries, in fact appreciably lower than its next door neighbor, Cambodia. Thus the data simply do not support the idea of a dramatically heightened level of birth defects in Viet Nam; the publicity is all about children whose unfortunate conditions are normally distributed in the population.

Is it possible that some individuals happen to have super sensitivity to some factor they encountered in Viet Nam? Certainly, there are small minorities of people who are made ill by sulfites in wine, by rubber gloves, by house dust, and even by sunlight. In any population of millions, there are bound to be a few individuals who react to something that effects no one else, or at least a very few others.

Unfortunately, Agent Orange has become a highly emotional topic, and one that both motivates some researchers to keep getting funding for more research, or seems to attract some environmental activists as a tremendous crusade to be conducted. Bias in scientific research is supposed to be avoided, but in truth scientists and others are fully subject to biases and slanted world views that lead them to believe in and very actively work at establishing as fact things that are actually perceptions. And others, like the government of Viet Nam, are simply motivated by the desire to extract large sums of money from others.

How to understand parts per million, per billion, and per trillion

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R J Del Vecchio is a Viet Nam veteran, served with the 1stMarDiv in 1968, working up and down the length of I Corps, the northernmost military district of South Viet Nam.

Mr. Del Vecchio is also a degreed chemist, with a long career in industrial chemistry, who examined a great deal of data relating to the Agent Orange topic over several years. He found that the majority of investigations were agenda dominated, that is, the point of the inquiry was to find effects on people supposedly exposed to the herbicide.