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The Political Science of Agent Orange

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Jungles and forests have always presented problems for armies operating in areas that are contested by hit-and-run or guerrilla forces. If you have the chance to see the movie *The Devil's Disciple* on an old movie channel, it graphically depicts the success of the American Colonials in slowing the progress of General "Gentleman Johnny" Burgoyne's British Army through the New England forests during the Revolutionary War. Almost two centuries later, the shoe was on the other foot when U.S. forces were at initial disadvantage in the bloody battles of the jungle island campaigns of the Second World War. Not surprisingly, chemical herbicides to kill or strip the leaves from trees to deny concealment to the enemy appeared as an attractive preventive for such battles in the future.

Military scientists who worked on those projects as well as scientists working to develop weed-killers for the civilian market were successful, and chemical defoliants and herbicides were liberally applied to post World War Two farms and forests, golf courses, suburban lawns, and railroad, utility, and highway rights of way. Many of those same chemicals were used during the Vietnam War.

Between 1961 and 1970, the United States military sprayed the herbicide Agent Orange, a mixture of two widely used agricultural chemicals, over the enemy-controlled jungles (now called "rain forests") and crop-growing regions of South Vietnam.¹ Agent Orange was shipped to Vietnam in 55-gallon drums circled by a stripe of orange paint for easy sorting from other herbicides – Agents White, Blue, and Purple, etc. While under development in the mid-1940s, one of the chemicals in Agent Orange – 2,4-dichlorophenoxyacetic acid or 2,4-D – was used to kill dandelions in front of the Smithsonian on the National Mall. It continues in worldwide use as an effective herbicide against broadleaf weeds, and it's available in every hardware and most grocery stores in Weed-Be-Gone and other popular products.

The other Agent Orange component – 2,4,5-trichlorophenoxyacetic acid or 2,4,5-T – was removed from markets around the world, after about 30 years of use, in the late 1970s and 80s because of concerns that dioxin, specifically 2,3,7,8-tetrachlorodibenzo-para-dioxin or 2,3,7,8-TCDD or TCDD, an unavoidable contaminant of the manufacture of 2,4,5-T, was a cause of cancer and other diseases.²

In fact, the risks from dioxin were overstated. In 2001, the Environmental Protection Agency's Science Advisory Board concluded that EPA has been unable to show that dioxin is a cause of human cancer and other diseases.³ Furthermore, studies of workers exposed to much higher levels of dioxin than experienced by any Vietnam veteran have failed to produce any conclusive evidence of connections between dioxin and cancer⁴ and the other health effects⁵ claimed by veterans.

The United States stopped using Agent Orange in Vietnam in 1970, eight years before it was taken off the market in this country. North Vietnamese and Viet Cong charges that the defoliants were a form of chemical warfare forbidden by international treaty contributed to that

decisions as well as claims from Vietnamese, Americans, and others that the defoliants were causing birth defects among Vietnamese children and severe, perhaps irreversible, ecological damage. The most important immediate factor in the decision was laboratory tests that showed dioxin to be the most potent cause of birth defects ever tested in laboratory animals.

Veterans' Claims

By 1975, veterans, supported by some scientists and politicians, were demanding medical treatment and monetary compensation for their own diseases and for birth defects in their children that they blamed on Agent Orange. Their efforts received a huge boost from two television programs that associated Agent Orange with cancer in veterans and birth defects in their children.⁶

The programs found audiences ready to believe that Agent Orange caused diseases. For one thing, the United States public, long ago disenchanted with the Vietnam War and, by the late 1970s, immersed in guilt about its treatment of Vietnam veterans, willingly accepted the idea that a chemical – Agent Orange – was at the root of veterans' complaints. Moreover, environmental chemicals as the cause of human disease were staples of nightly newscasts, magazine and newspaper articles, environmental organizations' fund raising and public relations campaigns, lawyers looking for companies to sue, and government officials eager to increase the reach of their agencies by expanding the fight against disease-causing environmental pollution. Agent Orange and dioxin became the ugly poster children for nasty environmental chemicals.

Through 1978, the Veterans Administration (VA) rebuffed veterans' claims for treatment and compensation for "Agent Orange diseases," saying that there was no evidence for a link between Agent Orange and the diseases for which claims were made. The veterans then took their claims to Congress.

Congress Orders Studies about Health Effects and Agent Orange Exposures

Congress could have responded to veterans' claims by directing the VA to provide medical care and to pay compensation to the veterans, in the absence of any evidence about causation, basing its decision on compassion or other policy considerations. It did not do that. In retrospect, if it had, it would have been a cleaner political decision as compared to the legislative obscurity and bad scientific decisions that followed.

The clamor for providing treatment for Agent Orange-related diseases decreased in the 1980s when the VA, with increased funding for its hospitals (Public Law 97-72, enacted in November 1981) provided treatment for "Agent Orange-related diseases." Importantly, the veteran did not have to prove exposure to Agent Orange to qualify for treatment. Instead, Congress presumed that exposure to Agent Orange caused the veteran's illness unless a congenital condition or some other exposure was shown to be a more likely cause.⁷ In practice, the law makes any disease in Vietnam veterans treatable as an Agent Orange disease because rigorous tests would be necessary to set aside the presumption.

In 1979, Congress (Public Law 96-151) ordered VA to plan and carry out a study of the health of Agent Orange-exposed veterans.⁸ VA failed to get the study underway in a timely manner (in fairness to VA, such a study had never been done, and it was far beyond the expertise and experience of VA staff). The Centers for Disease Control (the agency is now the Centers for Disease Control and Prevention, but I'll use the old name and abbreviation "CDC," a part of the Department of Health and Human Services, DHHS) maneuvered itself into being made responsible for the study in 1982.

CDC's "Vietnam Experience Studies."

In 1982, because there was no way to determine whether an individual had been exposed to Agent Orange, CDC decided to compare the health of Vietnam veterans with the health of veterans who had not served in Vietnam in the "Vietnam experience studies."⁹ A quick summary of this research is to say that the CDC found nothing to link Vietnam service with any health problems that had not been seen in veterans of other wars.

Many people, who had looked for the Vietnam Experience Studies to verify that the war was causing health problems, were disappointed. In particular, and with justification, they said that the effects of Agent Orange might have been overlooked because there was no way to identify veterans who had been exposed to it.

CDC's Measurements of Agent Orange Exposure.

After it enters the body by absorption through the skin, inhalation, or ingestion, dioxin, the chemical contaminant in Agent Orange, is deposited in the lipid (or fat) of the human body. It is very stable and only very slowly eliminated from lipid so that measuring dioxin concentrations in lipid today can provide information about exposures that happened decades ago. In the mid-1980s, CDC imported more sensitive methods and instruments from Sweden that allowed scientists to determine dioxin levels in blood, which is about four percent lipid. Blood sampling is a part of many epidemiologic studies, making it possible for CDC to do an Agent Orange study.

In its Agent Orange exposure study, the CDC identified 600 Vietnam veterans who had been present at times and in areas near where the Air Force's Operation Ranch Hand had sprayed Agent Orange and compared the concentrations of dioxin in the blood lipids (these concentrations are called "body burdens") of those veterans to the concentrations in some 100 other veterans who

had never served in Vietnam. The dioxin concentrations in the "exposed" and non-exposed veterans were the same, and the concentrations in both groups fell within the background concentrations measured in the general population.¹⁰

These results were no surprise to experts in pesticide application and dispersal, who had argued all along that the concentrations of Agent Orange reaching the ground where troops might be exposed were insignificant.¹¹ Some veterans and some members of Congress dismissed these results, as they had dismissed the results of the Vietnam Experience studies, as incompetently done or, worse, as "cover-ups."

The Ranch Hand Study

In 2005, the Air Force will complete its 20-year-long study of the health of the 1,200 Ranch Hands, the Air Force personnel who sprayed 90 percent of the Agent Orange used in Vietnam, and a Comparison group of Air Force personnel who flew similar planes to the C-123s flown by Ranch Hands in Southeast Asia but did not handle herbicides. Measurements of dioxin levels confirm that many of the Ranch Hands were exposed to Agent Orange.

The Ranch Hands and Comparisons have undergone week-long physical and psychological examinations at 5-year intervals beginning in 1982. The examinations are carried out in civilian hospitals by physicians and technicians who are not told which men are in the Ranch Hand and which are in the Comparison group. The Air Force has published the results from the first four examinations (done in 1982, 1987, 1992, and 1997), and the final results will be published as data is collected and analyzed from the 2002 examination.

The Air Force scientists who direct the Ranch Hand study have concluded that dioxin exposure is associated with increased risk of adult-onset diabetes because diabetes is more common

in the Ranch Hands with higher dioxin levels.¹² I disagree with that conclusion because the incidence of diabetes is the same in the Ranch Hands and the Comparisons, which is not consistent with an association between exposure and risk.

In their most recent comment on the possible dioxin - diabetes link, the Air Force scientists state that the glimmers of evidence that there was a connection from data collected in the 1992 physical exams of the Ranch Hands and Comparisons “were weaker” in the 1997 exams.¹³ I doubt that anyone besides the Air Force investigators, who are under enormous political pressure “to find something” that is associated with Agent Orange, an Institute of Medicine (IOM) committee , and some champions of Vietnam veterans’ health claims would interpret the available data to indicate that any connection exists.

To its great credit, the Air Force has made all its records and analyses – suitably stripped of personal identifiers – available to anyone who requests them.¹⁴ The Air Force study’s web page, <http://www.brooks.af.mil/AFRL/HED/hedb/afhs/afhs.html>, provides citations to all the Air Force study publications and the text of some of the publications. It also provides information about obtaining data from the studies.

Politics Takes Over

As study results rolled in and the terrible things believed to result from Agent Orange exposure weren’t seen, politics played a bigger role. During the late 1980s, VA established its Advisory Committee on Environmental Hazards¹⁵ and appointed as chairman, retired Admiral Elmo Zumwalt, a fierce partisan in the Agent Orange controversy, who blamed his son’s cancer and his grandson’s neurological condition on the son’s exposure to Agent Orange in Vietnam.

Responding to an analysis of possible links between Agent Orange and diseases sponsored by the American Legion, the Vietnam Veterans of America, and the National Veterans Legal Services Project,¹⁶ Zumwalt's committee concluded that a linkage existed between Agent Orange exposure and two relatively rare tumors, soft-tissue sarcomas and non-Hodgkin's leukemia. VA, acting on the committee's conclusions in 1990, declared that it would compensate veterans who developed either of those two tumors.

In 1988, congressional leaders, led by then-Representative, now-Senator Daschle, who pushed the Agent Orange-causes-diseases agenda, faced a dilemma. The despised CDC studies had been negative. There was no expectation of designing a study that would differ very much from those studies or that the results would have been different.

Congress could have set aside the scientific findings and based its decisions on other factors -- compassion, equity, log-rolling, pork-barreling, vote-buying – or it could have sorted among competing findings and conclusions and chosen those that satisfied its criteria for objectivity or political usefulness. As part of the usual course of politics and veterans compensation, Congress followed the advice of the Zumwalt committee and declared that Agent Orange had caused soft tissue sarcomas and non-Hodgkin's leukemia. It went farther in Public Law 102-4, "The Agent Orange Act of 1991,"¹⁷ passed unanimously by both the House and Senate, when it established a committee in the Institute of Medicine (IOM), within the jurisdiction of the prestigious National Academy of Sciences (NAS), to provide advice about health effects of Agent Orange.

Currently in 2002, the world exists as if the CDC and Air Force studies had never been done. Based on conclusions from the IOM committee, the United States government is compensating Vietnam veterans for some 10 "Agent Orange-related diseases" – that number will surely increase – and it is compensating their children born with a serious birth defect.

Politicians who promoted the idea that Agent Orange has been a scourge among veterans, and other citizens who receive compensation or otherwise benefit from those results, and the far larger number of citizens who see the compensation decisions as the "right thing" to do, laud the IOM committee for its "good science." In their eyes, the IOM has extracted truth from the morass of bad experiments, bad observations, bad studies, and bad interpretations that do not support the politicians' conclusions and the citizens' claims. In reality, the process has substituted an officially sanctioned, politically constrained objectivity for science at the IOM.

The IOM Committee Process

The IOM committee found little information to bring to bear on questions about the health of Vietnam veterans, and most of the reliable information came from the CDC studies, which offered no support for conclusions about exposures or effects of Agent Orange. The committee surveyed the world's literature about health effects among people who might have been exposed to dioxin, picked the studies that said there might be a link between exposures and disease, and concluded that some sort of statistical association existed between Agent Orange and about a dozen diseases. I want to emphasize that few of the studies considered by the IOM committee had any validated information about exposures, and the data in those few do not support associations between dioxin and disease. The IOM committee says repeatedly that it is determining only that a "statistical association" exists and that it is not determining whether there is a scientific association, but it never defines what constitutes a statistical association.

Currently, with some restrictions, the VA compensates any Vietnam veteran who develops lung cancer or prostate cancer, the two most common cancers in males, because of the links drawn by the IOM committee between Agent Orange and those diseases. It also compensates Vietnam

veterans who develop diabetes, which affects more than 10 percent of all men.

To its credit, the IOM committee recently reversed its earlier decision that linked veterans' exposures to Agent Orange with leukemia in their children. The committee reversed itself because a mistake had been made in the single study of children born to Australian veterans that supported the link.¹⁸ Nevertheless, the IOM committee's original decision that there was an association demonstrates the members' willing suspension of disbelief and scuttling of scientific skepticism. There is no evidence that ground troops – including the Australian troops – were exposed and there is no evidence from any animal or human study that exposures of male parents can cause cancer in their offspring. In any case, however, the IOM committee's reversal is a welcome change. At the time of the IOM committee's reversal, the VA was in the process of making a recommendation to Congress about compensating veterans' children with leukemia, and that process will not continue.

Far more ominous for public policy, the IOM committee decided that there is a connection between Agent Orange exposure and spina bifida, a birth defect resulting in incomplete closure of the spinal column. The committee ignored the fact that there is no evidence for any exposure to a male parent ever having caused a birth defect and no plausible biological mechanism by which it could do so. The spina bifida compensation represents the first time the VA will pay for health effects in veterans' children.

Thus, government is now into multi-generational compensation. There's no reason that compensation payments must end with veterans' children. Because evidence that convinced no other scientific review body was sufficient to convince the IOM committee that Agent Orange had caused a birth defect, there is no reason that equally flimsy evidence in the future won't convince the committee or its descendants that Agent Orange is, somehow, causing birth defects in veterans' grandchildren.

Indeed, some Vietnamese scientists, just as Admiral Zumwalt made claims about his grandson, are claiming health effects in grandchildren in their country. In accord with an agreement signed between the U.S. and Vietnam in 1995, Vietnam dropped all claims to compensation for war-related injuries, but the Vietnamese government claims that one million of its citizens suffer from Agent Orange-caused illnesses, and compensation claims are a possibility.¹⁹

Will the U.S. Ever Finish Paying for the Vietnam War?

Should the IOM decide that there is some evidence that a Vietnam veteran's exposure (or possible exposure) is related to a health problem in his grandchildren, or, should the VA decide to compensate for health effects in grandchildren, there would be no end to claims for adverse health effects. The result could be that the United States will never finish paying for the Vietnam War.

A decision to compensate grandchildren would also increase Vietnam's insistence on compensation and the scope of its claims. Vietnam bases its current claims on the undeniable facts that Agent Orange was sprayed in that country and that the U.S. government is compensating Vietnam veterans and their children. The Vietnamese government and others make the equity argument that the U.S. is compensating its own citizens, and it should be required to compensate Vietnamese.

Agent Orange and Dioxin Decisions: Political or Scientific?

The most damning indictment of the IOM committee's deliberations and conclusions came early in March, 2002, at a meeting about Agent Orange in Hanoi. At that meeting, contrasts were drawn between the compensation that is being paid to American veterans and the absence of compensation for Vietnam citizens. In an interview, Christopher Portier, Director of the National

Institute of Environmental Health Sciences (NIEHS) and Chairman of the Hanoi meeting, dismissed U.S. decisions to compensate U.S. veterans for “Agent Orange-related diseases” as “political.”²⁰

Remarkably, Portier, who along with William Farland of EPA who was also at the Hanoi meeting, has spearheaded EPA’s efforts to label dioxin as a human carcinogen and to calculate human risks from environmental exposures to dioxin. Acting as an employee of the U.S. government and making decisions about regulating industries for exposures to dioxin, Portier shows no doubt that his analyses and conclusions are scientific. Seeing his own employer, the U.S. government as a possible target of Vietnamese compensation demands, he dismisses the IOM committee’s very similar decisions about the health effects of Agent Orange as “political.” Regardless of the motivation that caused Portier to dismiss the IOM committee’s and the VA’s decisions as political, the dismissal may signal a change in government policy toward the IOM or the agent orange issue.

On To The Gulf War.

In the 1980s and 1990s, I heard discussions that Agent Orange was an issue because it originated in an unpopular, un-won war and that the public felt guilty about the treatment of the men and women who had been sent to fight that war. The Gulf War was popular, and it was won, but plenty of health effects have been linked to it.

Almost before the war was over, some Gulf War veterans blamed their service for essentially every disease known to man. Unlike Vietnam veterans who fixed their blame on Agent Orange, the Gulf War veterans have not focused on a single possible cause for their illnesses.

The spokespersons for Gulf War claims do, however, rely on the Agent Orange saga. Repeatedly, they say that it took 20 years and more for Vietnam veterans to obtain justice in the form of compensation for Agent Orange-related diseases and point to government evasions as reasons for the delay. Gulf War veterans, they say, demand justice sooner.

After a decade of patiently examining and finding no validity to claim after claim, the Department of Veterans Affairs and the Department of Defense, in December 2001, accepted the argument that Gulf War service causes Lou Gehrig's disease. No matter that the research was not published in a peer-reviewed journal. No matter that the research that supposedly supports the claim was not released at the time the decision was made. No matter that hardly anything is known about the causes of Lou Gehrig's disease other than that it is associated with some heritable chromosomal alterations. No matter that no environmental cause has been postulated for the disease. I expect that the number of Gulf War-associated diseases will lengthen now that the first entry has been made on the list.

“War Syndromes.”

The idea that wartime service causes disease did not originate with Vietnam or the Gulf War. Three Navy physicians²¹ who surveyed the literature about “poorly understood war syndromes” going back to the Civil War wrote:

it is noteworthy that the somatic symptoms frequently described by Vietnam veterans who may have been exposed to Agent Orange are similar to the symptoms commonly associated with other war-related illnesses, including acute combat stress reaction and post-traumatic stress disorder

and

veterans from diverse military units of the United States, Great Britain, and Canada began reporting various chronic symptoms, often referred to as the Gulf War

syndrome. Fatigue, headache, muscle and joint pain, diarrhea, skin rashes, shortness of breath, and chest pain have been common symptoms.

The symptoms of fatigue and so forth were reported in all the wars, and they have been variously attributed to psychological damage and infectious diseases. Blaming war as the cause of long-delayed health effects, such as cancer or birth defects among children, probably had to wait until environmental chemicals were identified, in the public's mind, as causes of such illnesses and birth defects.

Environmental Chemicals and Diseases.

I have written extensively about environmental issues, and taking EPA's data at face value, environmental chemicals are associated with no more than about one percent of all cancers, and probably less.²² I have not studied other diseases so intently, but I know of no data that indicate that environmental chemicals cause birth defects.

It will be a long time, however, before environmental chemicals lose their horrific image. The EPA constantly warns of their risks, Members of Congress can always capture headlines by pointing to environmental risks, and environmental organizations publicize risks to raise money. Moreover, "chemicals cause disease" is a sure-fire news lead.

The Future for the U.S. Military.

The U.S. military can look forward to its operations being blamed for all the illnesses for which environmental chemicals are blamed. In the first place, the military uses most chemicals that are used in civilian life – 2,4-D and 2,4,5-T in Agent Orange for instance – and, in the second place, no specific chemical need be suggested as a cause for a war-related disease – the Gulf War as a cause of Lou Gehrig's disease, for instance.

The performance of the U.S. military in the War Against Terror will surely cause critics of the military to mitigate their accusations, but I do not expect the forbearance to last forever.

Indeed, will anyone be surprised by the announcement of an Afghan War Syndrome?

The military has taken some steps to collecting more information while troops are deployed to better understand risks that may be encountered and any health effects caused by them.

For military operations in Bosnia, which began in 1995, environmental and infectious disease surveillance teams have been deployed; U.S. troops are being provided extensive health guidance before, during, and after the operation; medical and psychological screening will occur before and after deployment; and a repository for serum collected before and after deployment is being established [from Hyams et al., 1996].

Such efforts are continuing, but I worry that they may backfire in the same way that the Air Force's study of the Ranch Hands has backfired as some members of Congress, some veterans, and some environmentalists call it a hoax because it didn't confirm popular ideas about Agent Orange. Any military effort that doesn't support claims about adverse health effects is likely to get the same treatment. There's no question that such efforts must be made, however.

I have only nebulous suggestions for what the military can do to convince its troops, veterans, and the public that it is concerned about the health of servicemen and women, but the charges that wartime service has caused long-delayed health effects, birth defects, and childhood cancers are nebulous as well. In fact, the nebulousness and plasticity of the charges make specific suggestions impossible. Here are four ideas.

First, military spokespeople need to be forthcoming about the terrible psychological consequences of combat – killing, seeing friends blown apart, extended sleep deprivation, terror, and wounds. The military has made great strides in affording treatment and compassion to troops that suffer battle-related psychoses. Equally important, it should take the lead in lifting stigmas that remain attached to troops who suffer those effects. More public attention needs to be focused

on the evidence that combat neuroses and psychoses are a matter of time and intensity of combat and not some sort of weakness or failure. Anyone seeing a soldier suffering from physical manifestations of the psychological hell of warfare should know they result from war-induced stress, not from the soldier's weakness. And the soldier should have assurances that everyone understands that. And, of course, the physically wounded should be afforded all the psychological support needed. I mention this here, but I don't think that it is a current problem.

Second, military medicine leaders need to explain to Members of Congress and their staffs that the evidence that environmental chemicals cause human health effects is far from convincing. And they have to say that the shoddy evidence is being used to pillory the military and to commit taxpayers to paying compensation for diseases that effect every population – veteran and non-veteran – into the distant future.

Third, military leaders need to be candid with, and about, the veterans' service organizations. Those organizations picture themselves as fervently patriotic, and, indeed, on most issues they are. To the extent that they promote the fallacy that Agent Orange caused birth defects, diseases, and deaths, they harm the military. To the extent they promote the Gulf War Syndrome in the absence of good evidence, they harm the military. Those organizations are placed in a difficult position because their recruitment efforts are enhanced by their capacity to secure benefits for members, but it might be possible to convince them to insist on the best science before compensation decisions are made that will besmirch the reputations of the armed services.

Fourth, there may be opportunities to capitalize on the threat of Vietnam's possibly demanding compensation because the U.S. is compensating its veterans for "Agent Orange-associated diseases." Surely, some in Congress will listen to the judgment of Dr. Portier of NIEHS and the many U.S. scientists who characterized the compensation decisions as "political," which

they were, and see the folly of substituting political judgments for scientific ones about health effects in future wars.

Finally, the military has to be diligent about protecting its troops' health, quick to remove them from risky situations where that is possible, and honest about risks and health effects.

¹ For general information about the use of Agent Orange during the Vietnam War, see Gough, M. *Dioxin, Agent Orange* [New York: Plenum, 1986] pp. 63-120 and Institute of Medicine. *Veterans and Agent Orange* [Washington: National Academy Press, 1993] pp. 23-110.

² Gough, 1986, pp. 137-148.

³ U.S. Environmental Protection Agency, Science Advisory Board. "Dioxin Reassessment – An SAB Review of the Office of Research and Development's Reassessment of Dioxin." [Washington: EPA, May 2001] (EPA-SAB-EC-01-006). Hereafter, SAB, 2001.

⁴ Starr, T.B. Significant Shortcomings of the U.S. Environmental Protection Agency's Latest Draft Risk Characterization for Dioxin-Like Compounds. *Toxicological Sciences* 64 (2001): 7-13.

⁵ SAB, 2001.

⁶ Wilcox, F.A. *Waiting for an Army To Die* [New York: Random House, 1983] p. x presents a dramatic description of one of those television programs.

⁷ see IOM 1994, p. 50, and references there.

⁸ See IOM 1994, p. 50, and references there and Gough 1986, pp. 89-103. As part of the legislation that mandated the Veterans Administration study, Congress directed the Office of Technology Assessment to review and approve the plan for the study and to monitor the conduct of the study. I was put in charge of that activity in early 1980.

⁹ The Centers for Disease Control (CDC) Vietnam Experience Study. Postservice Mortality Among Vietnam Veterans. *Journal of the American Medical Association* 257 (1987): 790-95. CDC. Health Status of Vietnam Veterans. II. Physical Health. *Journal of the American Medical Association* 259 (1988): 2708-2714. CDC. Health Status of Vietnam Veterans. III. Reproductive Outcomes and Child Health. *Journal of the American Medical Association* 259 (1988): 2715-2719.

¹⁰ The Centers for Disease Control Vietnam Experience Study. 2,3,7,8-tetrachlorodibenzo-p-dioxin Levels in US Army Vietnam-era Veterans. *Journal of the American Medical Association* 260 (1988): 1249-1254.

¹¹ See, for instance, Gough, 1986, pp. 259-262.

¹² Henrikson, G.L., N.S. Ketchum, J.E. Michalek, and J.A. Swaby. Serum Dioxin and Diabetes Mellitus in Veterans of Operation Ranch Hand. *Epidemiology* 8 (1997): 252-258.

¹³ Michalek, J.E. and N.S. Ketchum, 23 April 2002, "Diabetes and Dioxin in Air Force Health Study Participants," typescript, 9 pp, prepared for the Department of Health and Human Services advisory committee to the Ranch Hand study.

¹⁴ I chaired the Department of Health and Human Services advisory committee to the Ranch Hand study when the decision was made to make the study data available to the public.

¹⁵ See Institute of Medicine 1994, p. 51, and references there.

¹⁶ Agent Orange Scientific Task Force: Human Health Effects Associated with Exposure to Herbicides and/or Their Associated Contaminants Chlorinated Dioxins: Agent Orange and the Vietnam Veterans. A report prepared for the American Legion, Vietnam Veterans of America, and the National Veterans Legal Services Project, 1990. Photocopied typescript, 55 pp.

¹⁷ Bill Summary & Status for the 102nd Congress: H.R.556, Public Law: 102-4 (02/06/91). <http://thomas.loc.gov/cgi-bin/bdquery/D?d102:1>.

¹⁸ IOM. "Revised Analysis Leads to Different Conclusion about Agent Orange Exposure and Childhood Leukemia." Press Release, February 27, 2002. News@nas.edu.

¹⁹ "A Killer Still." *The Economist*, March 9, 2002, p. 48.

²⁰ "U.S. Scientists Question Vietnam Dioxin Studies." Reuters, March 4, 2002. Dr. Portier confirmed that he made the "political" decision; personal communication, telephone call, April 30, 2002.

²¹ Hyams, K.C., F. S. Wignall, and R. Roswell. War Syndromes and their evaluation: From the U.S. Civil War to the Persian Gulf War. *Annals of Internal Medicine* (1996) 125:398-405.

²² Gough, M. How Much Cancer Can EPA Regulate Away? *Risk Analysis* (1990) 10:1-7.