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Dow Goes to War

If Saran Wrap hadn't done the trick of making Dow a household name, napalm surely did.

Cathy Trost, *Elements of Risk*

One image of the Vietnam War still prominent in public memory is the 1972 photograph, “Vietnam Napalm,” taken by Associated Press photographer Huynh Cong “Nick” Ut near the war’s end. It recorded a tragic scene near the village of Trang Bang, Vietnam. At the photograph’s center is a crying, Vietnamese girl, about eight years old or so. She is nude and her arms are extended bird-like as she runs down the middle of a country road. She is flanked by other children, also running and crying. Behind them on the road, are a few soldiers, and further in the background, is a sky filled with smoke from a freshly bombed village. The nude girl had shed her clothes after being hit with napalm—the jellied, liquid explosive used in combat. Napalm stuck to the skin, continuing to burn through muscle and bone, frequently killing its victims through the excruciating pain inflicted. Ut’s photograph, winner of a Pulitzer Prize that year, leaves a painful reminder about the particular horror of that unpopular war, and some of the nasty weapons used.

General Earle Wheeler, chairman of the U.S. Joint Chiefs of Staff, explaining why napalm was important in the war, said it helped penetrate dug-in Viet Cong and North Vietnamese positions. Conventional bombs were not as effective, he said. “Napalm, by nature of its splashing and spreading, can get into such defensive positions. It’s also especially effective against antiaircraft positions, because normally the enemy digs a hole—... and puts his machine gun in that hole.... The napalm splashes in and incapacitates the crew and sometimes destroys the weapon.”¹

Jellied gasolines for use in warfare were not a new invention for Vietnam. They were used in the flamethrowers of World War I, World War II, and Korea. But for napalm, there were some new twists in the chemical formula. In 1964, the U.S. Air Force developed Napalm “B”—50 percent polystyrene, 25 percent benzene, and 25 percent gasoline. Napalm’s delivery was also improved,

developed as a bigger and more awesome aerial firebomb delivered from aircraft. Dow Chemical, then the leading manufacture of polystyrene, was one of 17 American companies asked by the government to submit bids on producing napalm. The orders were to be filled in 25-million-pound lots. By 1966, Dow became a government contractor to produce napalm for the U.S. military. Napalm was relatively easy to make: a simple mixing of the ingredients—gasoline, benzene, and polystyrene. Dow set up a small production line and tankage system combining the three chemical ingredients at its Torrance, California plant. With a small group of workers, Dow proceeded to meet its napalm contracts over the next four years. Napalm was never a big business for Dow, and according to one estimate, the company never made more than \$5 million worth of napalm in any one year. Yet it became an infamous product for Dow, and thrust the company into the public limelight as never before. Napalm became a focus of the 1960s anti-war activists, and with it, Dow was cast as the government's handmaiden in the war.

Weapons Producer

Dow Chemical was no stranger to weapons production and government contracting. From World War I on, Dow did what the government asked, and repeatedly served as its wartime chemist and producer of munitions, strategic materials, and weapons—from mustard gas in WWI to plutonium triggers for nuclear weapons during the Cold War and beyond. During WWI, Dow's phenol provided the basis for making explosives. It also produced tear gases bromacetone and xylyl bromide,* and was involved in the development of mustard gas, also known as blister gas for the effect it caused on the skin. The Germans first used mustard gas in the war without much effect in 1915, but in 1917, they used it successfully in a five-mile breach of British and Canadian front lines. It soon became the Germans' preferred gas weapon, which they further refined and perfected. By February 1918, Dow officials were among a handful of key people summoned to Washington to come up with a way to produce and manufacture large quantities of the gas for the Allies. Midland soon became the Army's base for making the needed mustard gas compound—dichlorethyl sulfide. The Army then estimated its need at 40 tons per day. The G-34 plant in Midland, Michigan was built to produce half that amount. By war's end, there was a combined military and civilian production force of about 3,000 workers in

*One of the principle scientists working at Dow laboratories recalled that in the frantic crash effort to ramp up production of xylyl bromide at Dow in Midland in the winter of 1917–18, "considerable" amounts of it were spilled in the ice and snow. Upon the spring thaw, however, one area of the plant "became a very uncomfortable place" for several weeks as the spilled chemicals warmed and vaporized, producing their intended teary effects on unfortunate workers.

Midland turning out the gas and other products. There were also spills and accidents, and some soldiers detailed to Dow's production operations during the war died from exposures after cleaning out machinery that had gummed up. But in the end, the gas manufactured at Midland was shipped to France but was not used by the Allies, according to Dow biographer, E. N. Brandt.² Still for Dow, WWI was a bountiful time, even if the lethal gases only played a small role in the company's burgeoning chemicals list. More importantly, new knowledge and position were gained for the post-war world to come. The company's work with wartime gases, had given it valuable insight into ethylene, a key building block of incalculable value.

During WWII, Dow again played a key role in producing strategic materials, especially light-weight magnesium used in the production of long-range bombers, and styrene and butadiene, two key chemicals used in making synthetic rubber. Phenol production—now revamped in a new process since WWI—also made Dow the leading producer of this explosives ingredient for U.S. and Allied forces. Hexachloroethane, the principal ingredient in smoke screens, was also produced by Dow at its Midland, Pittsburg, and Freeport plants.³ Dow's chemicals were used in a wide range of products shipped to the military, including "... incendiary bombs, flares, and tracer powder, camouflage paints, germicides, fungicides and preservatives, gun muzzle covers, water purifiers, greases and oils, dyes, shoe polish, shaving cream, shell casings, map protectors, soaps, explosives and other products too numerous to list."⁴ A top-secret substance called impregnate, or "CC2"—a material used to treat combat clothing to make it resistant to gas warfare agents such as mustard gas and *Lewisite*—was also made by Dow in Midland. During the years 1937–41, explains E. N. Brandt, "Dow was by far the fastest growing of the nation's large chemical firms, averaging 26 percent in annual growth during a period when one expert estimated growth for the top ten firms in the industry at an average of 3.2 percent yearly, and much of Dow's growth was in products that were to be key to the war, such as magnesium and styrene."⁵

'60s Protests

But in the Vietnam War of the 1960s, it was napalm that made Dow a target of activist protests. One of the first such protests aimed at Dow occurred in late May 1966 at Dow's New York headquarters at Rockefeller Center. Peace groups, including some 75 protestors from groups such as Citizens' Campaign Against Napalm and Women Strike for Peace, handed out leaflets on the street. In their street taunts and protest literature, the protestors charged, "Napalm Burns Babies!" and other such slogans. They called on consumers to boycott Dow products such as *Saran Wrap*. Between 1966 and 1970, Dow was the focal point of more than 200 major anti-war demonstrations on American college campuses. Dozens of other

protests and incidents aimed at Dow also occurred—ranging from the bombing of the company’s office in Frankfurt, Germany and protests at various Dow plants around the world, to the trashing of the company’s Washington, D.C. offices. By the fall of 1967, the Dow protests were occurring so frequently—133 campus demonstrations aimed at Dow employment recruiters in that year alone—that the company began publishing a newsletter for key managers and campus recruiters to keep them informed of where protests might be expected. It was called *Napalm News*, and it ran from November 1967 to late March 1969.⁶

The legacy of napalm for Dow, however, was that it pushed the company into the national limelight. Well known and admired in central Michigan as a symbol of economic prosperity and new products, Dow was fairly obscure elsewhere. Napalm and Vietnam changed that. “In the time of the flower children,” as Dow biographer Brandt put it, using a common 1960s counter-culture descriptor, “Dow became a household word.” In 1965, one public opinion survey found that only 38 percent of the American public had heard of the Dow Chemical Company. Four years later, 91 percent “knew something about” the company. “What made [Dow] famous,” says Brandt, “was the war protests in which it was involved, which were front page newspaper and TV news fare throughout that period.”⁷ Long after the protests disappeared, however, people continued to associate Dow with napalm. Wrote one *Wall Street Journal* reporter in 1987, “Dow still gets questions about napalm, even though it stopped making the flammable gas gel 17 years ago.”⁸ But there was also something else from the 1960s that clung to Dow in an unflattering way: Agent Orange, a herbicidal defoliant made by Dow and also used in Vietnam. Unlike napalm, the Agent Orange chemicals came home to America with returning Vietnam veterans—in their blood, body tissue, and DNA.

Agent Orange

From late 1961 to 1970, the U.S. military in Vietnam undertook a massive chemical spraying campaign to defoliate Vietnam’s forests. The chemical most extensively used was called Agent Orange, owing to the orange band on the drums the herbicide was shipped in. The main ingredients in Agent Orange were two agricultural herbicides—2,4,5-T (2,4,5-trichlorophenoxyacetic acid) and 2,4-D (2,4-dichlorophenoxyacetic acid). Other herbicides, in mixtures designated Agents Purple, Pink, Blue, and White, were also used.*

*2,4,5-T was used in Agents Orange, Purple, and Pink, but not Blue or White. Agent White, for example, contained a mixture of 2,4-D (2,4-dichlorophenoxyacetic acid) and picloram (4-amino-3,5,6-trichloropicolinic acid), concocted in an approximate ratio of 4 to 1; and Agent Blue, was code named for cacodylic acid (dimethyl arsenic acid). But Agent Orange was the most widely used Vietnam defoliant.

Dow became the largest of nine government contractors supplying herbicides for the war. At a price of \$7 a gallon, Dow eventually supplied about one-third of the nearly 13 million gallons of Agent Orange the government used in Vietnam.⁹ But Dow did not invent the chemicals used in the Agent Orange concoction. That happened elsewhere, 20 years before.

In 1941, scientists at the botany laboratories of the University of Chicago were conducting research on plant hormones and plant growth, and had synthetically produced chemicals that affected various kinds of plant growth. The substances were then called “plant growth regulators,” not herbicides. However, the Chicago researchers became frustrated in their work by the lethal action of the chemicals they were testing. All the plants were dying. That’s when one scientist got the idea that the chemicals might in fact be put to that very use—specifically to kill weeds that plagued most crop farms. With some experimentation, they found their idea worked quite well. That’s when the government stepped in. About that time, the Chicago chemicals had come to the attention of the National Academy of Sciences’ War Research Committee and the U.S. Army. The Army was then becoming interested in biological warfare research, and shortly recruited the leader of the University of Chicago botany lab to begin secret military research on the herbicides at Fort Detrick, Maryland. Between 1944 and 1945, the Army tested the effects of more than 1,000 different chemical compounds on living plants at Fort Detrick. Among these were 2,4-D and 2,4,5-T. The use of the compounds in warfare was seriously contemplated at the time, but never actually unleashed in the war.¹⁰

With the end of WWII, herbicides soon made their way to U.S. agricultural experiment stations, private companies, and farmers. In 1945, the American Chemical Paint Company (later named AmChem, which subsequently became a part of Union Carbide) began selling the first systemic herbicide—2,4-D—under the brand name *Weedone*. Two years later, 30 different preparations of herbicides containing 2,4-D were being sold in the United States, including brands sold by Dow. By 1949, more than 23 million acres of agricultural land were being treated with herbicides of all kinds. 2,4,5-T by then was also registered under the federal pesticide law, known as the FIFRA, the Federal Insecticide, Fungicide and Rodenticide Act, then administered by the U.S. Department of Agriculture (USDA). In 1950, Dow began producing 2,4,5-T at its Midland, Michigan operations. By 1959, nearly 60 million acres of U.S. agricultural lands were being treated with herbicides of all kinds.¹¹ 2,4-D and 2,4,5-T were among the most widely used, with 2,4-D even reaching the lawn care market.

In the Vietnam War, the U.S. military first authorized the use of herbicides in November 1961 to improve visibility along roads and waterways and to clear camp perimeters. But that soon expanded to clearing areas suspected of harboring North Vietnamese or guerrilla base camps, then to supply routes, and also for destroying crops. By the mid-1960s, 2,4,5-T and 2,4-D were being dumped by the planeload over thousands of acres in Vietnam.

The U.S. Air Force created the 309th Air Commando Squadron to conduct the spraying. Originally code named “Operation Hades,” the spraying campaign later became known as “Operation Ranch Hand.” On the ground, American soldiers would see vegetative death by super growth—giant bananas and luxuriant jungle growth; growth that quickly wilted and became dying forests. Some soldiers, told the spray was harmless, would even engage in spray fights occasionally, while a few would even ingest the chemical to show reporters how safe it was.

Yet, even as the U.S. military was beginning its Vietnam spraying in 1962, back home, Rachel Carson was raising a lone voice of warning about pesticides with her book *Silent Spring*. Noting that 2,4-D and 2,4,5-T had become widely used agricultural herbicides, she reported on some of the early lab results and health-effects then beginning to appear. “People spraying their lawns with 2,4-D and becoming wet with spray have occasionally developed severe neuritis and even paralysis,” she noted. 2,4-D, said Carson, “has been shown experimentally to disturb the basic physiological process of respiration in the cell and to imitate X-rays in damaging chromosomes.” Other research, she warned, “indicated that reproduction of birds may be adversely affected by these and other herbicides at levels far below those that cause death.”¹²

There were some indications that the U.S. military wanted a safe defoliant—or at least a few of its key people at the time made statements to that effect. In 1963, at the Defense Department’s First Defoliation Conference reviewing Vietnam spraying operations, Brigadier General Fred J. Delmore alerted chemical company representatives, including those from Dow and Monsanto, that there was a need for the defoliants to work in a quicker fashion, and that the material used for the defoliants must be both “perfectly innocuous to man and animals,” but able to “do its job.” Additionally, Albert Hayward, chief of the Fort Dietrich program coordination office told those attending the conference, “It goes without saying that the materials must be applicable by ground and air spray, that they must be logistically feasible, and that they must be nontoxic to humans and livestock in the areas affected.”¹³ Dow officials then extrapolated from the company’s experience with its agricultural herbicides, advising General Delmore in 1963: “We have been manufacturing 2,4-D and 2,4,5-T for over ten years. To the best of our knowledge, none of the workmen in these factories have shown any ill effects as a result of working with these chemicals.”¹⁴

In 1963, the Advanced Research Projects Agency did hire the Institute for Defense Analysis (IDA) to review the toxicity of all the herbicides proposed for use in Vietnam. The IDA reported that it couldn’t guarantee if any of them would be safe for military use, also noting the military penchant for over-kill concentrations, with possible effects on the exposed population and domestic animals. The IDA recommended that the military take extra precautions. But the military didn’t follow this advice. In the war, if safety proto-

cols existed, they were mostly ignored. “The methods for transporting, loading, and spraying these chemicals were haphazard and sloppy,” observes Peter Sills, working on a book about Agent Orange. “Stuff leaked everywhere, and nobody cared very much.”

Sills also explains that Agent Orange was sprayed at much higher concentrations than any of the domestic uses of 2,4,5-T or 2,4-D. “Dow and the other manufacturers knew all of this,” he explains, “and must have realized that the risks were

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much greater than normal.” And while the Army Chemical Corps scientists approved Agent Orange as safe, “the Corps got most of its data straight from V. K. Rowe, Dow’s chief toxicologist,” says Sills. “Rowe is even quoted in the press release announcing the Corp’s decision.”¹⁵

By 1963–64, Dow was producing 2,4,5-T for the military at full throttle. In 1964, there were incidents of Dow workers contracting chloracne, a severe skin rash. But little of this surfaced publicly at the time, as the herbicidal mixtures were pretty much known only to the chemical industry and the U.S. military. Nor was any government agency then connecting the dots between what some may have been finding in agricultural pesticides used domestically and what was being dropped on Vietnam. The U.S. military, meanwhile, had not undertaken any Agent Orange toxicological testing of its own before ordering and deploying the chemical. Observed Thomas Whitesides in his book *The Pendulum and The Toxic Cloud*: “. . . [T]he American military, having developed 2,4,5-T as part of its biological warfare program in the years following the Second World War, unhesitatingly employed it during the war in Southeast Asia, spraying twenty thousand tons over both populated and unpopulated areas of South Vietnam, without the Pentagon’s scientists ever having taken the precaution of systematically testing whether the chemical caused harm to the unborn offspring of as much as an experimental mouse. . . .”¹⁶

In 1964, reports began to circulate in Vietnam of increased miscarriages, stillbirths, and birth defects among exposed Vietnamese women and farm animals. These reports came to the attention of scientists at the National Cancer Institute. The reports from Vietnam, plus other findings on the use of 2,4,5-T and 2,4-D domestically, convinced some U.S. scientists they ought to take a closer look at the chemicals, including the Agent Orange mixture. As it happened, the National Cancer Institute had already contracted Bionetics Research Laboratories of Bethesda, Maryland in 1963 to conduct cancer studies on a number of pesticides, including 2,4-D and 2,4,5-T. Bionetics’ studies were then to be reviewed by a blue ribbon commission of scientists. In the summer of 1965, Bionetics’ tests on female mice and rats showed that

2,4-D and 2,4,5-T caused a significant number of deformities in unborn offspring. A preliminary report on these findings was prepared in 1965 and 1966, but was not made public.

Bionetics' tests had found that a production impurity in 2,4,5-T known as dioxin* was a powerful teratogen—a substance that caused birth defects in the rat offspring. A number of the offspring were born dead or deformed, some with cleft palates, no eyes, cystic kidneys, and enlarged livers. Dow Chemical, then the principal American producer of 2,4,5-T, objected to the findings, saying the 2,4,5-T sample Bionetics used was a “dirty sample” and unrepresentative because it contained abnormal amounts of dioxin. No decisive action was then taken by the government; the Bionetics study remained under wraps and 2,4,5-T continued to be used both domestically and in Vietnam. Some critics suggested that Dow, the nation's leading producer of 2,4,5-T, simply pressured the government to hold back the report. In addition, observes author Carol Van Strum in her book, *A Bitter Fog*, “the White House apparently feared that disclosure of the Bionetics report would encourage international criticism of American chemical warfare in Vietnam and feed growing antiwar sentiment at home.”¹⁷ However, in July 1969, Ralph Nader received a leaked copy of the Bionetics report and made it available to Dr. Matthew Meselson, a Harvard University biologist. Meselson was concerned about the Vietnam spraying and helped to gather the signatures of 5,000 scientists petitioning Lyndon Johnson to stop the use of herbicides in Vietnam. The United Nations adopted a Swedish resolution that declared the use of herbicides a violation of the Geneva Protocol of 1925. President Nixon, however, drew a different interpretation.¹⁸

Meanwhile, in places like Oregon and Arizona, Louisiana and Arkansas, and Pennsylvania and North Carolina, some of the same Agent Orange chemicals—2,4,5-T and 2,4-D—in various combinations and mixtures, were being sold and sprayed regularly. In these applications, too, Dow was a leading purveyor, promoting their use practically everywhere—in American forests, along railroads, highways, and transmissions lines, and on farms, rangelands, lawns, and golf courses.

Back at the White House, Nixon administration science advisor, Dr. Lee A. DuBridge, reacting to public criticism over the leaked Bionetics test results, decided to take some action and ordered “restrictions” on the use of

*2,4,5-T is manufactured by chemically combining 2,4,5-trichlorophenol sodium salt and chloroacetic acid at elevated temperatures and pressures under alkaline conditions. The substance 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD)—or “dioxin” for short—is an inevitable byproduct of 2,4,5-trichlorophenol and 2,4,5-T production. Dioxin is the key toxic substance in these and other compounds, and would later be discovered as a much wider problem throughout the chemical industry as well as other industries. Dioxin will be explored in more detail in the next chapter. Here, for the moment, suffice it to say that dioxin was beginning to be understood by a small circle of government and industry scientists as a very potent toxic chemical.

“Viet Cong Poison the Water”

During the Vietnam War, as charge and counter-charge flew back and forth about Agent Orange’s use and effect on the civilian population and environment, the American military engaged in a bit of its own propaganda, using helicopter-mounted public address megaphones blaring messages to South Vietnamese villages. One episode, in Binh Dinh province, recounted below by Carol Van Strum in her 1983 book, *A Bitter Fog*, is based on the account of a Vietnam veteran who took part in it:

... Late in 1969, a young man [Paul Merrill, the Psychological Operations Combat Loudspeaker Team leader] crouched beside a 1,000-watt trumpet loudspeaker mounted on a frame that had been lifted into the helicopter. Beside him, another man readied boxes of leaflets, and just behind them, crew chief and gunner manned the machine guns on either side of the craft. The pilot brought the helicopter low over a small village at the mouth of a valley where two rivers met. A single two-story cement building dominated a cluster of mud and thatch houses. Buildings, paths, palm trees, banana trees, and dirt roads were contained within a concertina-wire perimeter, separating them from surrounding rice paddies.

As the helicopter circled the village, the young soldier swung the hinged speakers out the cargo door and tinkered with the control panel of tape recorder and amplifier. Grasping the strut of the seat, he leaned out the open doorway to throw the leaflets his partner handed him, while the loudspeakers blared their message in Vietnamese, in a voice clearly audible 7.6 kilometers away:

“The Viet Cong have been saying the sprays make the people sick and are making them sad, and that the sprays are killing the elders and the children. The Viet Cong are lying. They are poisoning the water, so the people will believe their lies. The Viet Cong do not like the sprays because they let the soldiers see where they are hiding.”

2,4,5-T. DuBridge announced, by White House order, that government agencies would stop using 2,4,5-T in populated areas, and that pesticide registrations for 2,4,5-T on food crops would be canceled by January 1970 unless the government could establish safe tolerance levels. The Department of Defense would also restrict the use of the herbicide to remote areas in Vietnam. “It seems improbable that any person could receive harmful amounts of this chemical from any of the existing uses of 2,4,5-T,” said DuBridge at the time of the announcement. “While the relationships of these [Bionetics] effects in laboratory animals to effects in man are not entirely clear at this time,” he continued, “the actions taken will assure safety of the public while further evidence is sought.” But journalist Cathy Trost writes that DuBridge’s move “was a hollow announcement. None of the promises was kept,” she says. “The Pentagon announced the very next day it would not alter its use of the herbicide in Vietnam because it believed its present policy conformed

to the White House directive....” Meanwhile, scientists such as Yale University’s Clement L. Markert, chairman of the biology department, were speaking out about the possible effect of 2,4,5-T. He told *Science* magazine that 2,4,5-T unquestionably exhibited a high order of toxicity and posed an unacceptable risk to the people of Vietnam, where it might cause hidden, if not overt, birth defects, such as lessening of brain capacity.¹⁹

By November 1969, a U.S. Department of Health, Education and Welfare panel named the Mrak Commission—reviewing the latest National Institute of Environmental Health Services findings—concluded that 2,4,5-T, some forms of 2,4-D, and several other then-registered pesticides, were found to be teratogenic and “should be immediately restricted to prevent risk of human exposure.” Dow, meanwhile, continued to object to the findings. According to Dow biographer Brandt, “On December 27, 1969, the federal office of Science and Technology summoned a group of Dow scientists to Washington to tell them all they knew about 2,4,5-T. The Dow group told a panel of distinguished scientists among other things about a new methodology to determine [dioxin] level recently developed by Rudy Stehl of Dow.” At this time, Dow appears to have continued to argue that the Bionetics samples were dirty, coming from another company which Dow charged had a very high impurity level in its manufacturing. “If Bionetics had selected a Dow material or that of almost any other manufacturer, the teratogenic effects would not have been detected,” said Warren B. Crummett, one of Dow’s experts, in a 1994 interview.²⁰ Yet, in 1970, after new tests were conducted using “cleaner” 2,4,5-T, the results from the National Institute of Environmental Health Sciences and the Food and Drug Administration—using samples that contained less than one part per million dioxin as Dow had requested—still showed 2,4,5-T to have significant teratogenic effects in test animals, including cleft palates, missing limbs, and skull defects.^{21*} Dow conducted its own tests and did not find the birth defects detected in the government tests. The federal government, by this time however, was ready to act.

In April 1970, at U.S. Senate hearings on the health effects of 2,4,5-T conducted by Senator Phillip Hart (D-MI), U.S. Surgeon General Dr. Jesse Steinfeld, presented a chronology of research dating back to 1966 that also showed the chemical to be teratogenic. Dr. Steinfeld and David Packard, Secretary of Defense, announced formally on April 15, 1970, the government’s

*Other tests in 1970 were also conducted, including those of Dr. Jackie Verrett of the FDA Toxicology Lab in Washington. Dr. Verrett used a 0.50 parts per million dioxin solution obtained from chemicals used in Vietnam and applied them to chick embryos and found cysts, necrotic livers, slipped tendons, cleft palates and beak deformities in the resulting broods. She also used a 0.25 parts per trillion solution and observed similar effects. Further tests of 2,4-D and 2,4,5-T without dioxin still produced dead and deformed offspring. Some tests in England at the time had also found that Agent Orange contained as many as 17 or more contaminants.

action limiting the use of 2,4,5-T in the United States and suspending Agent Orange use in Vietnam.*

By 1971, when the Vietnam spraying program ended, over 11 million gallons of Agent Orange containing some 50 million pounds of 2,4,5-T had been used in the spraying program.** In total, including other agents and other herbicides, more than 100 million pounds of herbicides were sprayed over at least 6 million acres of Vietnam between 1962 and 1971.²²

The Home Front

As the spraying of Agent Orange came to a halt in Vietnam, the use of 2,4,5-T and related herbicide formulations at home seemed to increase markedly in some applications. Even though the USDA, under White House orders, had moved by May 1970 to cancel registration of 2,4,5-T on food crops, gardens, recreation areas, and locations where it might contaminate water supplies, the herbicide still had a wide berth. It continued to be used in forests, along powerline rights-of-way, on rangeland, and other areas. In fact, by the mid-1970s, 2,4,5-T spraying across America *exceeded annually* in acreage the total 5 to 6 million acres that had been sprayed in Vietnam over more than eight years. Meanwhile, chemical producers, led by Dow, waged their own war against the federal agencies trying to rein in 2,4,5-T. The fighting began almost from the moment the first 2,4,5-T restrictions were announced in April 1970—a time when the federal government was also redefining its environmental and public health responsibilities, shifting pesti-

*Also testifying at the 1970s hearings was Dr. Julius Johnson, a vice president at Dow Chemical and director of research and development. Johnson reported on Dow's 1964 episode of chloracne among workers who handled wastes from 2,4,5-trichlorophenol at the company's 2,4,5-T plant. Johnson described chloracne as "a skin disorder mostly prevalent on the face, neck, and back." It is similar in appearance, he said, "to severe acne often suffered by teenagers," leaving the impression, in Thomas Whitesides' opinion, that "chloracne might seem... a transient cosmetic problem...." But there were indications even then that chloracne—and dioxin—were associated with maladies beyond the skin rash that Dr. Johnson described for the committee. In fact, Dr. Benjamin Holder, director of Dow's medical department, had only two months earlier told a group of government chemists that the early symptoms of the chloracne included fatigue, lassitude, depression, the appearance of blackheads on the face and back, and weight loss. He also reported that heavy exposure to dioxin-contaminated trichlorophenol waste caused damage to internal organs and disorders of the nervous system. (see Whitesides, pp. 24–25). But at the time, most of this went unnoticed, as the government's announcement limiting 2,4,5-T was what made the headlines.

**These were the numbers used for the next 30 years or more. However, recent investigations suggest the amount of land sprayed and chemicals used may have been greater. Researchers at the Columbia University School of Public Health, for example, have suggested amounts 10 percent higher than previously reported.

cide authority away from the USDA and toward a new agency called the U.S. Environmental Protection Agency (EPA). Amid these changes, Dow and other herbicide producers dug in their heels.

In May 1970, Dow, Hercules, and Amchem Products appealed USDA's decision to cancel the use of 2,4,5-T on rice. Under the law at the time, the continued use of the contested substance was permitted to proceed during the appeal process. By January 1971, the newly formed EPA was ordered by

Dow's maneuver in the Arkansas courts had gained the company nearly two years of continued 2,4,5-T sales for rice.

the courts to uphold the restrictions on 2,4,5-T. Several months later however, in May 1971, EPA's Science Advisory Panel found that 2,4,5-T did not create any health hazard and proposed to lift the ban around homes, although the panel

acknowledged the chemical's teratogenic potential and proposed language for a warning label: "This compound may be dangerous to pregnant women." In August 1971, after scientists, including Barry Commoner of Washington University, Matthew Meselson of Harvard, and Samuel S. Epstein of Case Western Reserve, and the U.S. Food and Drug Administration objected to EPA's Science Panel findings on 2,4,5-T, EPA administrator William Ruckelshaus, conducting his own review, decided to keep the 2,4,5-T cancellation order in place while calling for further hearings. Citing the known facts about lab animal birth defects stemming from dioxin in 2,4,5-T, Ruckelshaus warned of the possibility that even "pure 2,4,5-T" containing the lowest amount of dioxin, might be a hazard to man and the environment. He also asserted the chemical companies had failed to establish that either dioxin or 2,4,5-T did not accumulate in body tissue, as was then known for other chlorinated hydrocarbons.²³

Dow Chemical, meanwhile, had sent its lawyers to U.S. District Court in Arkansas—in the heart of the rice production belt where 2,4,5-T was then used heavily. There, Dow sought an injunction against EPA's ruling to continue the cancellation on rice. The court granted Dow's request and also required Ruckelshaus to issue a new ruling on the cancellation, which Ruckelshaus continued, declaring it was "abundantly clear" that Dow had not met the burden of proof to show 2,4,5-T was harmless. EPA then appealed the Arkansas ruling to the U.S. Court of Appeals in St. Louis.²⁴ But during the appeal, 2,4,5-T continued to be sold and used. Nearly two years later, in April 1973, the St. Louis Appeals Court sided with EPA, reversing and overturning the Arkansas decision that had allowed 2,4,5-T to be used on rice. Yet Dow's maneuver in the Arkansas courts had gained the company nearly two years of continued 2,4,5-T sales for rice.

EPA, however, still had its scheduled hearings on 2,4,5-T—on whether the herbicide should be banned for all uses. EPA staff had been preparing

their materials and arguments. Dow was preparing too, and spared no resources or affiliations in its attempt to keep the herbicide on the market, as Environmental Defense Fund's (EDF) Bill Butler recounts:

As the time for the hearing approached, EPA got more and more shaky as to what the evidence against 2,4,5-T was. The agency had only one lawyer on the case, and one, less than full-time staff scientist preparing the evidence. The outside interested parties such as the environmental groups, had formidable opposition. Dow had enormous scientific and financial resources at its disposal. Although we could consult with people like [Drs. Meselson, Robert Baughman, and Samuel Epstein] we had only one part-time scientist of our own to work on a very complicated issue. As we did our best to pursue the subject, Dow tried to bring as broad a coalition as possible against us, including the Department of Agriculture and the Department of Transportation. The agriculture people were solidly ranged against EPA. The Dow people wanted the Department of Transportation to testify about the importance of using 2,4,5-T to clear railroad and highway rights-of-way. Unfortunately for Dow, the Department of Transportation had a couple of people in the office of its general counsel who knew something about 2,4,5-T. These people had a study made of the experience of several state transportation agencies. The agencies who were questioned on the subject minimized the need for using 2,4,5-T to clear rights-of-way.

... Dow and the Department of Agriculture [about a month before the expected EPA hearings] put together what I can only call a sham conference on 2,4,5-T. It was supposed to bring together the biggest experts on 2,4,5-T and produce the definitive word on the subject. However, it turned out that the invited parties were mostly Dow employees and USDA folk, who proceeded to give as formal papers what in essence was their forthcoming testimony at the EPA hearings. We suspected that they were doing this so that if there were any conflicts in their proposed testimony these conflicts could be ironed out... In other words, it was a dry run to make everybody feel comfortable—a psychological ploy by Dow's attorneys, in my opinion...²⁵

Dow Shifts The Burden

Then in June 1974, EPA surprised environmental and other interests by calling off the long-planned 2,4,5-T public hearings. EPA also withdrew its cancellation order on the use of 2,4,5-T on rice. "EPA just got cold feet," said EDF's Butler at the time. "They were saying, in effect, that the agency would assume the burden of proving, through further research, that 2,4,5-T was harmful, rather than requiring Dow to show the herbicide was harmless."²⁶ This change, noticed first by lawyers and those involved closely with regulatory matters, was a key shift in the "burden-of-proof" battle that many

thought had been established in government policy—with *manufacturers* bearing the responsibility to prove chemical safety. Shifting the burden to the *government*—requiring a finding of harm in order to remove a pesticide from the market, rather than requiring the *manufacturer* to prove the substance was safe—was a seminal shift in regulatory philosophy. Dow had won an important precedent not only for itself, but for the rest of the chemical industry, and one that went well beyond 2,4,5-T.

As for 2,4,5-T, Dow continued to maintain—without full, independent toxicological proof, using essentially its 1940s pesticide registration—that the herbicide was safe to use. Although the company acknowledged dioxin’s toxicity, Dow scientists and salesman insisted dioxin’s low levels in 2,4,5-T formulations was not a problem.

“So, in effect, we are playing Russian Roulette.”

Sen. John Tunney, 1974

nearly insoluble in water and therefore did not tend to be taken up in water-courses. And finally, when 2,4,5-T was sprayed, Dow said, the spraying itself helped to diffuse the chemical—and the dioxin—over such large areas that the risk to human health was infinitesimal and essentially not a practical concern. Many of these claims would later be challenged and disproved, but at the time, there was little effective challenge to Dow.

In 1974, Congress undertook another round of congressional hearings on the woes of 2,4,5-T. Still, the herbicide emerged under a use restriction rather than a total ban. “So in effect,” said a frustrated Senator John Tunney (D-CA), witnessing government officials reluctant to ban a toxic herbicide, “we are playing Russian Roulette . . . We know it is harmful, and it is just very difficult at the moment to tell how harmful it is, and therefore we will just put our heads in the sand and pretend it doesn’t exist.”²⁷ 2,4,5-T continued to be used widely across the United States, sprayed on millions of acres. And Dow was its leading marketer.

Dow, in fact, had been selling the herbicide since the spring of 1948, the same year the company’s scientists began early trials of combinations of 2,4-D and 2,4,5-T. Dow’s Dr. Mullison had patented some of these new products, which were formulated in a way that made them somewhat less volatile and better plant penetrators. “The results look exceptionally promising,” said Dow in one 1949 promotional piece. Dow later extolled the results of one test application of the new mixture along 742 miles of the Delaware, Lackawanna & Western Railroad in Pennsylvania, credited with killing 85 percent of the brush. “Chemical weed killing,” concluded Dow, “is here to stay.” Dow soon added a new formulation called silvex, a slower acting form of the herbicide, marketed under the *Kuron* tradename, that was targeted to tougher weed species, even oak-type vegetation.

Miscarriages in the Forest

In the 1960s and 1970s, Dow and other herbicide producers had pitched their new weed killers hard to farmers and ranchers,* state highway departments, railroads, utility companies, and the timber industry. The U.S. Forest Service, in fact, became an important Dow customer, buying the company's herbicides in bulk quantities. Forest Service lands were sprayed with Dow herbicides containing 2,4,5-T, 2,4-D, silvex, and other ingredients in Oregon, North Carolina, Arizona, and a number of other states. Between 1972 and 1978, for example, over 7,000 acres of Oregon coastal forests were sprayed with 2,4,5-T. But like Vietnam, anecdotal and medical reports started coming in during the 1970s about birth defects and miscarriages, some of the earliest from the Pacific Northwest. One such case was that of Patty Clary, who had moved with her husband to Days Creek, Oregon in 1974. She lived in an area sprayed frequently by timber-company helicopters using the herbicides as part of their forest management practice. Mists from the sprays would occasionally waft down on the land where they lived, or drain into streams. Once, Clary was sprayed by a passing helicopter. Still, she didn't think much about it at the time. Her husband, in fact, worked as part of a "hack and squirt" forestry crew, using some of the same herbicides, residues from which were sometimes still on his clothes. Then Patty Clary had two miscarriages and also some serious hemorrhaging over a three-month period that sent her to the hospital. "Here I was, 29 years old, perfectly regular my whole life, and suddenly I had a 'hormonal imbalance.' Five doctors could not tell me what happened."²⁸

Patty Clary had two miscarriages and also some serious hemorrhaging over a three-month period that sent her to the hospital.

The coastal, forested Pacific Northwest is a well-watered environment, with lush growth and steep, irregular terrain. Helicopter spraying of timber company clear-cuts was being routinely used to wipe out weeds and keep new underbrush from taking hold before new Douglas Fir could be planted. But the runoff from those lands went right into streams, along with the sprayed chemicals. Drifting spray would also settle into streams and onto non-target lands—as it had near Allegany, Oregon in the 1970s. "The spraying goes on continually," explained Allegany resident Rose Anna Lee, describing her community to visiting *Environmental Action* editor Deborah Baldwin in late 1979. "Within one drainage system, maybe they'll hit the southeast unit one season, the northeast unit the next...I lived a quarter

*See Chapter 5 for a review of Dow's agricultural pesticide history.

mile downstream. My neighbors and I could smell the stuff. I could see it . . .” Lee’s young daughter, Angie, became ill. As her mother explained: “When Angie first got sick she didn’t feel that bad, but she was bruised all over. The doctor did blood tests and put her in the hospital. They found 2,4,5-T and silvex in her bloodstream. Angie was in the hospital for eight or nine months.

In 1979, EPA declared 2,4,5-T and Silvex to be imminent threats to human health.

Her spleen was removed. She came close to spontaneous hemorrhaging.” Angie was diagnosed with something called ITP, idiopathic thrombi-cytopenic purpura, a rare blood disorder that lowers the platelet count and prevents proper blood clotting. “Idiopathic” means the exact cause of the disease is not known, but some doctors at the time suspected it may be caused in part by exposure to toxic chemicals. “Angie was only seven,” continued her mother. “She was given massive doses of cortisone. She was in and out of a hospital in Seattle.” But after Angie’s platelet levels climbed back up, they would drop again on her return home. A year and half after the last hospital visit, Angie’s mother, Rose Anna Lee, decided it was time to move away from Allegany, Oregon. Others who remained there would soon report massive crawfish kills in the river.²⁹

In the Alsea, Oregon area, where 2,4,5-T spraying had gone on between 1972 and 1978, a small group of women who had experienced miscarriages following spraying began keeping personal diaries detailing the dates of spraying and their miscarriages. In the six-year period, nine women had suffered 13 spontaneous abortions. This data, anecdotal and unscientific as it was, got EPA’s attention. It was first reported to the agency in April 1978 by one of the Oregon women. Follow-up investigations and others studies were undertaken by EPA. By then, the agency had also started a process that would de-register 2,4,5-T. That meant it would be phased out unless a pressing need for it could otherwise be shown. Dow Chemical dug in to fight the proposed de-registration, and continued working to undo the existing restrictions.³⁰

“2,4,5-T is about as toxic as aspirin,” said one Dow representative in a 1979 television broadcast.

In late February 1979, EPA declared 2,4,5-T and silvex to be imminent threats to human health and issued an emergency ban, temporarily prohibiting the use of the herbicides on forests and rights-of-way. At a March 1st news conference on the emergency ban, EPA Deputy Administrator Barbara Blum noted that “dioxin, even at very low levels, causes severe reproductive effects—miscarriages and birth defects—and tumors in laboratory animals . . .” Noting the new studies in the Alsea basin of Oregon, Blum explained, “there is a statistically significant relationship between the spray

season and the high miscarriage peak,” which followed the application of 2,4,5-T by two to three months. “It’s a remarkable correlation,” said Blum.³¹ Yet even with the new emergency ban, other agricultural uses on 2 million acres of rice and rangeland were allowed to continue. Silvex was still permitted for use on apples, prunes, sugarcane, pears, fence rows, storage areas, and parking lots. Dow, meanwhile, maintained the product did not pose a health threat. “2,4,5-T is about as toxic as aspirin,” said one Dow representative in a 1979 television broadcast of *Plague on Our Children*, a PBS documentary.³² Dow Chemical, by this time, was preparing to sue EPA over the proposed ban.

Dow’s president, David Rooke, noted at the time that Dow “believes in fighting.” Explained Rooke: “We hung in on napalm when it didn’t mean anything business-wise. The government asked us to make it and we did. We believed in the principle.”³³ In its legal and regulatory deliberations, Dow

would take a methodical, strictly corporate and legal course in attacking EPA’s actions, going after its methodology and weak studies, while attacking uncertain science and the credibility of witnesses. Anticipating Dow’s line of defense and attack, Deborah Baldwin, editor of *Environmental Action*, observed at the time:

...Dow will also argue that the levels of dioxin in current batches of 2,4,5-T are so minute as to be inconsequential and that, in any event, the toxic contaminant breaks down in soil and “disappears” from the environment. Exposure to dioxin, the company will say, can pose only short term hazards, since the body “excretes” the chemical. The unusually

The Audubon Response

In the early 1970s, as spraying in the Pacific Northwest was proceeding, Carol Van Strum and others in her area sought the help of scientists, journalists, and national environmental organizations to aide their efforts and bring broader public attention to the use of herbicides. One of the groups they wrote to was the National Audubon Society and its magazine, *Audubon*. Van Strum explains:

... Hoping to add other voices to our own, we wrote to environmental groups and publications. Only one responded—indirectly. *Audubon* magazine had referred our letter to the Dow Chemical Company. Dow sent a thick package of company literature, including an elegant brochure on phenoxy herbicides. The brochure was illustrated lavishly with color nature photographs by Eugene Kenega, an assistant scientist for Dow who was also president of the Michigan Audubon Society.

The cover letter, explaining that Audubon had referred our letter to Dow for reply, was signed by Dr. Kenega. He praised us for our concern and repeated what he had already heard from USDA. The herbicides were safe. No harm could result if the EPA label instructions were followed...

Source: Carol Van Strum, *A Bitter Fog: Herbicides and Human Rights*, p. 9.

Shoecraft v. Dow

In the 1960s, Billie Shoecraft was a housewife and mother in her forties living with her husband and family in the canyon lands of the Tonto National Forest near Globe, Arizona. A spunky 5-foot-4, weighing 100 pounds or so, Shoecraft wore her hair in a bouffant flip and was a bit eccentric in her ways. In fact, some people around Globe called her just plain crazy. But Billie Shoecraft loved the canyon lands and the Arizona environment—she adopted them as home after going there from Indiana in 1948. But Shoecraft was no Barbie doll; she could ride a horse, handle a rifle, and helped build her own house. Nor was she an activist or environmentalist, though she loved nature and animals. On women's rights, she was characterized as "closer to Phyllis Schlafly than to Betty Frieden." But in the 1960s, Shoecraft embarked on a new career. Accidentally doused with a herbicide spray in June 1969, Shoecraft—then perfectly healthy—became ill and died from cancer at the age of 53. She attributed her illness to the continuing spraying of herbicides in the area, and while alive, fought furiously to stop it. For more than a decade, she and her neighbors took on the U.S. Forest Service and the herbicide establishment, ultimately bringing a lawsuit against Dow Chemical and others for their respective roles in the spraying.

Shoecraft had always been suspicious of the spraying in the national forest near her home. She was not alone. Other neighbors in the rural area also had experiences with the spraying, some reporting dead birds, sick domestic animals, damaged plants, and incidents of their homes and family members being sprayed. In fact, from 1965 to 1969, the U.S. Forest Service sprayed thousands of acres in the Pinal Mountains area of the Tonto National Forest with various mixtures of 2,4-D, 2,4,5-T, and 2,4,5-TP or Silvex. A large portion of the product was supplied by Dow Chemical. In 1966, Shoecraft once asked a local Forest Service ranger about a dying pine tree near her land, unaware at the time it had been sprayed. She was told it had a "mysterious disease." But it was the June 8, 1969 spraying in the Pinal Mountains area that pushed Shoecraft and her neighbors into an activist mode. Roused in the early morning hours of Sunday June 8 by the sound of a helicopter approaching her home, Shoecraft rose from her bed and went outside in her nightgown to have a closer look. Minutes later, when the copter flew over her house, she was sprinkled with something wet. She then phoned the local ranger's office for information, and not getting much help, decided to jump in her car and try to flag down the pilot. At one point, the pilot did pass over and hover near Shoecraft, who by then was out of her car and waving at him from the ground. There, Shoecraft was accidentally drenched again by the pilot, who blamed the release on a defective spray nozzle. After that incident, the pilot departed for repairs to his helicopter base. Later that day, however, the helicopter spraying continued, with several other residents in the area also reporting being sprayed.

By July 1969, Shoecraft and her neighbors started to press the Forest Service on the spraying program, calling for among other things, an analysis of all the hazards to plant and animal life. One Forest Service agent dismissed their reports of plant and animal damage as "a bunch of malarkey." The spraying, which

helped clear watersheds of water-clogging vegetation, was also supported by the giant Salt River Valley Water Users Association. Local ranchers supported it too, since it made more pasture. But some angry residents said they would shoot down aircraft flying over their property. Shoecraft and her neighbors had their land and plants tested and levels of 2,4,5-T and silvex were found. They soon began compiling documents, talking to the press and petitioning their congressmen and senators. More than 90 residents had come together to claim damage to their health, property, and animals. Shoecraft and her allies were not always well regarded by their neighbors, thought of as “on the fringe” or “crazies”—and they used protest-theater tactics on occasion, such as a mock funeral at the Forest Service office—that rubbed some locals the wrong way. Still, newspaper stories and radio shows began covering the issue. By mid-July 1969, Dow Chemical had a man go to the scene to assess the public relations situation. He pegged Shoecraft as the key player.

Shoecraft, meanwhile, had broken out with a blistery rash after the 1969 spraying incidents, and she'd been to local hospitals twice—once for difficulty breathing and swallowing, and another time for chest pains and pains in her extremities. Tests found nothing out of the ordinary. Shoecraft had some emotional strains, and some stress in her marriage at the time, but she was otherwise a very healthy person with no history of illnesses or health problems. But Shoecraft began piecing together past incidents of problems in her family—with herself, her children, family pets, and local plants and animals—correlating those with previous spraying dates. Some of her neighbors had done the same, finding what they believed was something more than coincidence. Shoecraft and friends upped their activism, and they continued to get notice, not all of which was flattering. Billie Shoecraft had samples of her fatty tissue tested in February 1970 and learned she was carrying all kinds of chemicals—DDT, lindane, endrin, and chlordane, among others. Silvex was also in her tissue at 35 ppm, and 2,4-D at 2.5 ppm.

In the spring of 1970, Shoecraft and 20 others in Globe, Arizona filed suit against Dow and three other chemical companies that made the herbicides sprayed in the area, as well as the helicopter company that did the spraying, the state agency that helped finance them, and separately, the federal government's U.S. Forest Service program. She also wrote a book on the spraying, called *Sue The Bastards*, which was published in Phoenix in 1971. Shoecraft's activism grew beyond Globe, and she was soon speaking to other activists. But by then, Shoecraft's health was deteriorating, according to records of her California doctor—she didn't trust the doctors in Globe. By 1971, Shoecraft was greatly fatigued, and taken to spending time in a cabin apart from her homeplace, which she believed contaminated and the source of her woes. By 1972, she was continuing to loose hair, had numbness on one side of her body, and extended periods of menstrual bleeding. Similar effects were reported through 1974. But during the legal proceedings with Dow and others, Shoecraft persisted despite her failing health, answering lawyers' questions in at least seven depositions between the fall of 1970 and the summer of 1974.

By the fall of 1974, the court case against the companies had been transferred out of state court into federal district court. A case against the federal gov-

ernment remained on a separate track. Over time, most of the chemical companies and the helicopter company had settled out of court. Dow, however, remained. Dow, for its part, hired Dr. Charles Hine, a San Francisco toxicologist who had served as a pesticide consultant to industry and had done some of the original research on DBCP. Dow hired Hine to perform a medical examination on Shoecraft. She had to fly to San Francisco for the session, which did not go well. She resisted some of the testing, having a pap smear done by another San Francisco lab rather than Hine. But Hine did get a blood sample from her, which was sent to Dow's lab in Midland for analysis. That analysis took more than year to complete, with no traces of herbicide or dioxin detected.

Through 1975, Shoecraft's health went into further decline, with continuing weight loss, depression, fatigue, menstrual bleeding, and difficulty swallowing. By then she was wearing adult diapers for incontinence. In early 1976, a Phoenix urologist found some nodules in her breasts and armpit. X-rays from another doctor showed collapsing vertebrae. By now, Shoecraft, with help from her family, was traveling to Tijuana for *Laetrile* to ease her pain. In July 1976, exploratory surgery by a family doctor found tumors throughout her abdomen, her liver, and her pelvis. "She's just full of it," her doctor was reported to have said, with no way to operate. Biopsies later showed the cancer in her ovaries. A sample of fatty tissue taken from Shoecraft and sent to GHT Laboratories in California also found traces of 2,4-D, 2,4,5-T and silvex. To be close to the *Laetrile*, Shoecraft and her husband Willard took up residence in San Diego for a time, then went back to Globe, where another Dow attorney visited for more fact-finding discovery. Right before Christmas 1976, the Shoecrafts went to Salem, Oregon for a doctor who could administer *Laetrile*. By December 28, Shoecraft was admitted to Salem Memorial Hospital where on January 6, 1977, she died. Cause of death was listed as malignant tumor in the ovaries and carcinomatosis—the spread of cancerous tumors throughout the body.

The litigation that Shoecraft and her neighbors had initiated seven years earlier, had proceeded. Some new attorneys had been added, and after a time, they assembled a prospective lineup of scientists to testify to help their case. Scheduled for a jury trial in October 1980, the case was later postponed until March 1981. Still, the Shoecraft lawyers felt they had a good case. Twenty-one formerly healthy people had been exposed to a herbicide containing dioxin. Dow had not done the long-term effects studies on Silvex. Dioxin was a known contaminate of 2,4,5-T, but Dow continued to claim 2,4,5-T was absolutely non-toxic to humans or animals. Dioxin was found in the herbicides sprayed in Globe at levels of least 0.15 ppm. Dow's warning label on the Silvex sprayed in Globe did not warn the Forest Service about the danger of spraying it in populated areas. The Shoecraft plaintiffs were suing for wrongful death, physical injuries, fear of cancer, and fear of birth defects. Dow's attorney, for their part, were planning to defend the company's products by playing up their importance to agriculture and minimizing the effects of dioxin exposures. They would admit that both 2,4,5-T and silvex contained trace amounts of dioxin, and like any other compound, from aspirin to zinc, in sufficient quantities it could produce adverse health effects. The compounds were well studied, the amounts of contaminant

tiny, and that no more than minor health hazards—covered by the product labels—were likely involved. As the trial date approached, both sides readied their final documents. Jerry Sullivan, one of the Shoecraft lawyers, said “no one is ever gonna have a better chance against Dow than you people.” Just as jury selection process began, however, Dow made a settlement offer. The Shoecraft litigants rejected it, and jury selection proceeded. But then, just as the judge was about to call for the trial to begin, Dow’s attorney telephoned him with another settlement offer—this time with a bigger pot of money, more, in fact, than the plaintiffs had asked for. Although there was some disagreement, and those who felt the case should continue on principle, the Shoecraft litigants settled and the case did not go to trial. There was no admission of guilt or wrongful activity on Dow’s part; no formal legal findings. Jerry Sullivan, one of the Shoecraft attorneys, wanted the trial. “We get doctors to testify. We get epidemiologists to testify. I had people calling me to testify. And they settle . . . You throw some money at people and they cave. . . . And Dow started throwing money at them. We would have had a jury finding of proximate cause, I know that. We would have had a finding that dioxin causes cancer. . . .” But even Sullivan, in the end, did not blame the plaintiffs for settling. Some had been through a grueling decade-long struggle; and a few of them were now in bad personal health and just wanted it all to be over with. Still, Billie Shoecraft, some observed, would not have settled.

Sources: Adapted from Cathy Trost, *Elements of Risk*, pp. 95–195, and Carol Van Strum, *A Bitter Fog*, pp. 35–46.

high level of miscarriages and birth defects . . . will be cited as an irrelevant, if troubling, coincidence. Timber companies such as Weyerhaeuser will protest the suspension . . . as an intolerable restraint on reforestation efforts and as an economic impediment that will cost the Northwest jobs. Dow will say the burden of proof in such controversies lies with EPA; government lawyers will say just the opposite . . .

Conclusive proof that 2,4,5-T causes birth defects, miscarriages and a host of related health problems can never be shown in court, and that’s something Dow is banking on. At best, EPA can put forward laboratory experiments on monkeys and rats and a troubling if inconclusive array of “anecdotal evidence”. . . .³⁴

By April 1981, EPA had backed off its attempt to ban 2,4,5-T, and began negotiating a settlement with Dow on more restrictive labeling requirements.³⁵ Dow would continue to sell the herbicide under selected restrictions. Gradually, however, the scientific record built against 2,4,5-T to the point where Dow finally quit making it in the United States in 1983. But the company had spent at least \$10 million defending its prized herbicide, keeping it on the market, at least in some form, for more than a decade after its first challenges. In fact, since 1969 when the very first restrictions were suggested for 2,4,5-T, Dow was determined to fight. As Dow biographer Brandt

“Chemical McCarthyism”

In April 1979, a PBS documentary produced by San Francisco television station KRON entitled the *Politics of Poison* began airing in California and around the country. The film focused on several small, Northern California timber towns that had received herbicide spraying, the residents of which had reported various health problems, including miscarriage and birth deformity rates in the 40- to 60-percent range. The film included interviews with officials from EPA and Dow Chemical—which the documentary reported had spent millions fighting government pesticide regulations. In the film, Dow’s spokesman, Cleve Goring, called the campaign against 2,4,5-T “chemical McCarthyism.” He defended Dow’s use of the chemical. Calling 2,4,5-T “a very important symbol,” Goring said if Dow were to lose on this issue, “it would mean that the American public has been really taken back a couple of hundred years to an era of witch-hunting, only this time the witches are chemicals, not people.” But *San Francisco Examiner* columnist Bill Mandel, had a different take on the film, noting among other points, that commercial interests were “spraying populated areas with herbicides considered too deadly for use as chemical weapons.” More than 40,000 letters from the film’s viewers were generated in California. The film was also shown in Washington during Congressional hearings. In June 1979, two weeks after the film was aired, Mendocino County voted overwhelmingly to ban aerial spraying of phenoxy herbicides such as 2,4,5-T and 2,4-D.

Source: Lewis Regenstein, *America The Poisoned*, 1982, p. 25.

put it: Dow “stubbornly attempted to defend the product, contending that 30 years of science had shown 2,4,5-T to be a safe and useful product. . . .” Dow claimed it had greatly improved its manufacturing process for 2,4,5-T, and that its dioxin content was negligible.

Some years later, Dow CEO Paul Orefice would say of the company’s ten-year 2,4,5-T battle: “If we let them ban a product that has 30 years of studies behind it that says it’s safe, what happens to the next product, and the next product, and the next? How many products would have been banned with no good reason if we hadn’t fought for 2,4,5-T. . . .?”³⁶ In October 1983, Dow closed its U.S. 2,4,5-T plant. Several years later, in August 1987, Dow announced in New Zealand it would close what was then believed to be the last 2,4,5-T production factory on the planet. Yet the decade of fighting over 2,4,5-T’s safety and use as a domestic product was only the opening salvo.

Vietnam Veterans Sue

Following the Vietnam War, returning American veterans began reporting illnesses of mysterious origin, and began to point to Agent Orange as the

suspected culprit. By 1977 or so, Vietnam vets began filing medical disability claims at the U. S. Veterans Administration (VA). They filed for a long list of problems, including skin rashes, nervous disorders, dizziness, chronic coughing, impotence, liver and kidney disease, loss of sex drive, cancer, and birth defects in offspring. In most cases, the VA refused to acknowledge any of the illnesses were connected to Agent Orange.

In June 1979, calling the government's failure to adequately investigate Agent Orange and its

Some 9,000 vets filed lawsuits against Dow and other Agent Orange producers, seeking \$44 billion in damages.

effects on Vietnam vets "a national disgrace," Congressman Bob Echarde (D-TX) held hearings that produced some dramatic witnesses. One of those testifying was Michael Ryan, a Long Island, NY policeman who had been exposed to Agent Orange in Vietnam and had suffered extreme weight loss and other illnesses. Accompanying Ryan that day were his wife and daughter Kerry—a daughter conceived after Ryan had returned from Vietnam, and who was born with severe deformities. Neither Ryan nor his wife had any family history of birth defects. "... Kerry, a frail child with short brown hair, sat in her wheelchair gazing wide-eyed at the television cameras, the Congressman high on the wood-paneled dais, and the roomful of lobbyists and reporters," wrote Margot Hornblower for the *Washington Post*. "... Kerry was born eight years ago with 18 birth defects: missing bones, twisted limbs, a hole in her heart, deformed intestines, a partial spine, shrunken fingers, no rectum..."³⁷ Michael and Maureen Ryan would later write, in a 1982 book entitled *Kerry: Agent Orange and an American Family*: "Some of these executives from the chemical companies belong in jail. We have veterans and children who have spent years trying to cope with catastrophic disabilities without help. Now that we know who is responsible, we want help for the veterans and we want the people who sold them out to go to prison for it. They're criminals. They knew."

By 1982 there were more than 12,000 vets who had filed Agent Orange-related claims at the VA, some 852 of which were allowed—but only for other causes, not Agent Orange. Soon there were lawsuits brought by the veterans aimed at both the government and the chemical manufacturers. Some 9,000 vets filed lawsuits against Dow and other Agent Orange producers, seeking \$44 billion in damages. The cases were eventually consolidated, and at the time became the largest product liability case in U.S. history, and one of the first mass tort class-action cases. The veterans' case raged in argument for months in the Brooklyn, New York, U.S. District courtroom of Judge Jack Weinstein. It was finally brought to a settlement in 1984. The settlement established a \$184 million compensation fund for the vets, funded by the seven major producers of Agent Orange—Dow, Uniroyal, Monsanto, Hercules, Agricultural Nutrition, Diamond Shamrock, and Thompson Chem-

ical. The payments were to be distributed to the vets and their families over ten years. Disabled vets received from \$256 to \$12,800, and families of deceased vets from \$340 to \$3,400. Eventually, about 39,000 vets received money from the fund, with an additional 28,000 claims denied. By January 1995, more than \$160 million had been paid out, with some \$21 million still remaining in the fund.³⁸

In 1996, studies by the National Institute of Medicine found that exposure to Agent Orange might be linked to higher rate of spina bifida in veterans' children.

However, a number of veterans and those following the case felt the 1984 settlement was a bad deal, and that vets really didn't get their due. The judge played a key role in pushing both sides to a set-

tlement, which excluded all future claims. Nevertheless, in 1989, the widow of a Vietnam veteran filed a second class-action lawsuit on behalf of other veterans. That case was filed in Texas state court. However, the chemical companies requested that the federal courts transfer the case back to its last jurisdiction in New York, under Judge Weinstein, who had presided in the last case, and had ruled, in the view of many, in industry's favor. The widow's attorney argued the chemical companies really had no legal ground for sending the new case back to the former judge, and that his client was being denied the right to an impartial decision-maker. But the case went back to Weinstein, and in April 1992, as the chemical companies had hoped, he dismissed it. The widow then appealed Weinstein's dismissal.³⁹

Congress, meanwhile, had passed the Agent Orange Act of 1991. Among other things, that law called on the National Academy of Sciences to review new Agent Orange and herbicide studies every two years to determine whether fresh research shed any new light on additional diseases. The latency period of some cancers can be 20 to 30 years. In March 1996, a second evaluation of studies by the National Institute of Medicine, found that exposure to Agent Orange might be linked to higher rate of spina bifida in veterans' children. The report also found a possible new association between Agent Orange and a nerve disorder known as transient peripheral neuropathy, that can result in temporary numbness, pain, and weakness in the arms and legs. In earlier studies, the institute found sufficient evidence to strongly link Agent Orange exposure to chemical acne and three types of cancer—non-Hodgkin's lymphoma, Hodgkin's disease, and soft-tissue sarcoma.⁴⁰

Back in court, veterans who had developed diseases since the 1984 settlement and were being denied compensation, had filed lawsuits. One was Daniel Stephenson, who discovered in 1998 that he had a deadly form of cancer. Another was Joe Isaacson of New Jersey. By the time Stephenson and Isaacson developed their diseases, however, the money from the 1984

Herbicidal Horrors Remain

In a tiny office at the Hue Medical College in Vietnam, Dr. Viet Nahn has some photocopies of U.S. Air Force maps sent to him by a U.S. veterans' organization. The maps show the number of herbicide spraying missions carried out over the Central Highlands region of Vietnam during the war—in particular, those in the province of Quang Tri, a province adjacent to the former DMZ, or Demilitarized Zone, a priority defoliation target. Dr. Nahn says it is this area where almost all his patients come from—places with names Americans may recognize, such as Khe Sanh, Hamburger Hill, Camp Carroll and the Rock Pile. At least 741,143 gallons of herbicidal chemicals were dropped in the central highlands area where Dr. Nahn is working, more than 600,000 gallons of which were Agent Orange. His office and its 21 volunteers try to do what they can for Vietnamese children afflicted with various diseases and health problems believed to be rooted in Agent Orange. Dr. Nahn, studying the impact of Agent Orange as a medical student, found numerous afflicted Vietnamese families when he went out to the villages. He soon established his small office and began performing operations on afflicted children—operations for hernias and cleft palates, open-heart surgery, and kidney transplants. The Vietnamese Red Cross estimates that one million Vietnamese have been disabled by Agent Orange.

Cathy Scott-Clark and Adrian Levy, reporters for London's *Guardian* newspaper, visited Vietnam in 2003 and found some of those victims. Some were adults, some were teenagers, some were young children—even grandchildren. All were connected somehow to the herbicide spraying. The reporters saw adults suffering from skin lesions and goiters; children with various birth defects, including large heads, enlarged, bubble eyes, altered limbs, and others with severe depression or no control over themselves. They were also told of women who spontaneously abort or give birth to genderless babies “that horrify even the most experienced midwives.” According to former vice-president of Vietnam, Madame Nguyen Thi Binh, returning veterans in Vietnam were eager to have children and build families to repopulate their devastated country. However, many of the first-born children in these families had birth defects, so the veterans tried again and again. As a result, according to Madame Binh, there are a number of Vietnamese families that now have four or five disabled children.

In 2003, Ngo Luc turned 67 years old. He is former captain and sole survivor of his unit, which served in the Vietnam War as a North Vietnamese guerrilla unit. Today he lives with his two granddaughters, both born partially paralyzed, near the Vietnamese city of Hue in the country's Central Highlands. It was in that region during the war that Ngo Luc remembers the planes that circled overhead one day: “We expected bombs,” he says, recounting one incident to the *Guardian*, “but a fine yellow mist descended, covering absolutely everything.” Mr. Luc remembers being “soaked” in the spray, “but it didn't worry us, as it smelled good. We continued to crawl through the jungle.” The next day, he remembers, “the leaves wilted and within a week the jungle was bald.” Mr. Luc and his men “felt just fine at the time.” But years later that would change not only for Mr. Luc's family, but for hundreds of thousands of Vietnamese—ex-soldiers, farmers, and their offspring.

“Cancer, miscarriages, and birth defects in the sprayed areas are always higher than in the areas not sprayed,” said Tran Manh Hung of the special committee on Agent Orange in Vietnam’s Ministry of Health. “It might take another 50 years before those rates become equal.” Vietnamese scientists, recently working with Hatfield Consultants, a team of Canadian environmental scientists, suspect their country may be contaminated with herbicidal residue for years, with a number of severe hot spots. In the Aluoi Valley, for example, an area adjacent to the Ho Chi Minh trail, and once home to three U.S. Special Forces bases where Agent Orange was both stored and sprayed, the scientists’ analysis has shown that, rather than naturally disperse, dioxin has remained in the ground in concentrations 100 times the Canadian safety levels for agricultural land. It has also spread into the area’s ponds, rivers, and irrigation systems, and into the food chain through fish, shellfish, chicken, and ducks that store dioxin in fatty tissue. Samples of human blood and breast milk in the area reveal that villagers have ingested dioxin, and that pregnant women pass it through the placenta to the fetus, and through breast feeding, to newborn babies. More than 15,000 children and adults from this region have been registered as suffering from an array of chronic health problems. “We theorize that the Aluoi Valley is a microcosm of the country, where numerous reservoirs of TCCD still exist in the soil of former U.S. military installations,” says Dr. Wayne Dwernychuk, vice president of Hatfield Consultants. There may be as many as 50 of these “hot spots” throughout the country. Some, such as the former U.S. military base of Bien Hoa, also had spills—including one 7,500-gallon Agent Orange spill which occurred on March 1, 1970. In addition, former Ranch Hand pilots allege that there were also some 26,000 aborted spraying operations during the war in which some 260,000 gallons of herbicide were simply dumped on the countryside. One former pilot based at Bien Hoa during 1968–69, claims he regularly jettisoned his chemical into the Long Binh reservoir. Military regulations required spray planes and helicopters to return to base empty.

Source: Cathy Scott-Clark and Adrian Levy, “Spectre Orange,” *The Guardian*, March 29, 2003.

settlement had all been paid out. In fact, by 1997, all the settlement money was gone, leaving veterans such as Stephenson, Isaacson, and others without any compensation. And their claims had been denied by lower courts. In early 2003, however, these cases were brought for review before the U.S. Supreme Court. In a rare 4–4 tie, the Court’s action resulted in allowing veterans who missed the original settlement to sue. “A lot of veterans have been waiting ten years to hear this,” said Gerson Smoger, Oakland, California attorney representing the two veterans. Smoger and his plaintiffs had been working to show that the Agent Orange class-action settlement was inadequate since it was not helping the injured Vietnam veterans. “Their rights are vindicated,” he said, of his clients’ opportunity to now seek compensation. However, Dow and a number of industrial colleagues, including insurance companies and trade groups such as the Product Liability Advisory Council, had filed friend-of-the court briefs in the case, and did not want any reopen-

ing of class-action settlements or further litigation. Dow's New York attorney, Andrew Frey, expressing frustration with the Court's tie vote, predicted the issue would eventually be brought before the high court again.⁴¹

To this day, researchers continue to find links between Agent Orange and various illnesses in Vietnam veterans. In January 2003, for example, it was reported that researchers at the Institute of Medicine, after reexamining past research on cancer rates in agricultural workers and residents of farm communities, had found a link between a type of leukemia and Vietnam soldiers exposed to herbicides such as Agent Orange. That finding prompted the U.S. Veterans Administration (VA) to extend benefits to Vietnam veterans with the illness. Veterans diagnosed with chronic lymphocytic leukemia, would start receiving improved benefits from the VA within a year, the agency said, which expects to find about 500 new cases a year among Vietnam vets. The VA reported at that time that 10,000 Vietnam veterans were receiving disability pay for illnesses related to exposure to Agent Orange and other herbicides used during the Vietnam War.⁴²

Worse Than Thought

Further study of U.S. military data on herbicide spraying in Vietnam has also turned up new information. In fact, the amount sprayed, the area sprayed, and toxicity of the sprays involved all appear to have been greater than previously reported. A study team at Columbia University led by Jeanne Mager Stellman undertook a historical reconstruction of the herbicide spraying using earlier National Academy of Sciences reports based on a U.S. military record of flight paths and sprayings known as the Herbicide Report System. The Columbia team's findings, published in *Nature* in April 2003, reveal that far more herbicides were used during the early years of the war than had been previously reported—including more dioxin-rich herbicides such as Agents Purple and Pink. In fact, the Columbia team found that more than 9.4 million liters of sprayed herbicide had not been previously counted, and some 200 missions flown during the war prior to 1965 were also missed. Those missions alone reveal that about 1.9 million previously unaccounted for liters of Agent Purple were sprayed between 1962 and 1965. And Agent Purple, according to the researchers, was likely to have had a dioxin content of as much as 45 parts per million (ppm). Agent Orange, in contrast, is thought to have contained 13 ppm dioxin, revised upward from an earlier estimate of 3 ppm. Others say such numbers can be misleading, as dioxin content in the sprays varied widely, and could have been much higher than the 13 ppm estimated for Agent Orange. Still, the Columbia recalculations indicate that the amount of dioxin sprayed was almost double that of previous estimates. And on the ground in Vietnam, the data reconstruction also revealed more detail—that some 20,585 towns were within the spraying

regions and that as many as 4.8 million people could have been present in these towns when the herbicides were sprayed.⁴³

So today, the Vietnam “war” is still being waged. The military hostilities are long gone, of course, but some “battles” still rage daily and hourly. These battles are fought quietly, individually—mostly in the blood and body tissue of too many living things—in Vietnam, America, and other far-flung places seem-

More herbicides were used during the early years of the war than had been previously reported—including more dioxin-rich herbicides such as Agents Purple and Pink.

ingly unconnected to the war. Yet they are connected—as are the Vietnamese citizens and America’s Vietnam veterans, who have more in common with one another than not. In fact, these former enemies are now on the same side. They are allies in league against a common enemy: the left-behind toxic timebombs ticking inside them and their families—and in the environment too. For whether in Vietnam’s highlands, Michigan lakes and rivers, or New Zealand’s cattle, the enemy is the same—the toxic 2,4,5-T and 2,4-D residues of the Agent Orange spraying and production frenzy. No one knows for sure how much or how widespread this left-over toxic chemistry is—as some of it still shows up occasionally in global commerce, not to mention continued legal uses of the herbicides in many places. But the health effects and human toll are becoming increasingly clear. Dow Chemical, of course, isn’t the only source. But from Michigan to Vietnam, there is one continuing common thread and chemical marker that keeps pointing back to Dow—a poison called dioxin.