Epilogue

Blind to the Truth?

Fifty years after Dr. Harold Hodge signed off on fluoride safety at Newburgh, we learned of a potentially disastrous biological threat posed by another class of fluorine chemicals known as perfluorochemicals (PFCs). PFCs are different from the fluorides discussed throughout the rest of the book, both in their chemical composition and in their toxicity.[1] But just like the fluorides in our toothpaste, PFCs—which include such brand names as Teflon, Gore-Tex, and Stainmaster—are an almost ubiquitous presence in our lives, found in numerous household products and employed in hundreds of industrial applications. And, once again, like fluoride, the story of how the toxicity of PFCs has been investigated or, more accurately, how that information has been suppressed, includes a disturbing link to the nation's nuclear program.

ON MAY 16, 2000, the giant Minnesota-based industrial corporation 3M made a startling and historic announcement: it was "voluntarily" withdrawing one of America's best-known household products, Scotchgard, from the market. With no current replacement available for the popular fabric protector and dirt repellant, and associated products, an estimated $320 million worth of 3M sales was being washed away. "Sophisticated testing capabilities," 3M explained in a press release, ". . . show that this persistent compound, like other materials in the environment, can be detected broadly at extremely low levels in the environment and in people. All existing scientific knowledge indicates that the presence of these

materials at these very low levels does not pose a human health or environmental risk."

"3M deserves great credit for identifying this problem and coming forward voluntarily," announced the EPA Administrator, Carol Browner, in response.

In truth, 3M had come forward about as "voluntarily" as a cornered tomcat in an alley. Behind the crafted public-relations spin of the 3M announcement lies a trail of exposed workers, a potentially profound threat to human health, a global environment once again polluted with a fluorine chemical, decades of corporate delay, and a staggering economic threat to a "fluoropolymer" industry with $2.5 billion dollars in international sales.[2]

It was DuPont that first recognized the commercial potential of organofluorines. By mass-producing refrigerant gases in the 1920s that combined fluorine, carbon, and chlorine (CFCs), the corporation generated a twentieth-century financial windfall.[3] The Manhattan Project quickly commandeered the wizardry of DuPont's fluorine engineers during World War II, using its radical new supersecret PFC oils and seals to lubricate and protect the government machinery in the Oak Ridge gaseous diffusion plant. (The "per" in perfluorinated means that the hydrogen atoms in a normal hydrocarbon chemical bond have been fully replaced with fluorine atoms. The chemical symbol H-C becomes F-C. That lock-tight fluorine-carbon clasp produced ultradurable chemicals that protected the government machinery from even elemental fluorine's corrosive powers.)

After the war a cornucopia of wondrous new household products based on fluorocarbon technology—including plastics, aerosols, pharmaceuticals, waterproofers, pesticides, specialized lubricants, and firefighting foams—soon tumbled from the laboratories and vast research programs that had been assembled by industry and the U.S. military.[4] The ability of the man-made PFC molecules to resist water, oil, and highly corrosive chemicals, made them the unseen servant for a host of modern creature comforts. Today the same types of PFC "polymer" chains that once helped process uranium hexafluoride for the Manhattan Project carry fast-food French fries for McDonalds in greaseproof wrappers and allow spills to be wiped from carpets impregnated with DuPont's Stainmaster

fabric protector. "It allows us to do so much which we now take for granted," said British scientist and fluoride historian Eric Banks. He dubbed fluorine "the enabling element," for the bounty it contributes to modern living.

However, just like DuPont's CFC refrigerants—which were once thought safe and inert but then tore a hole in the ozone layer—the manufacture and use of Scotchgard and other PFC chemicals may have very definite *human* health risks. By the end of the twentieth century not only had millions of tons of durable CFCs soared high into the stratosphere, but their PFC cousins had quietly penetrated deep into our bodies and blood.

In 1996 the scientists Theo Colborn and John Peterson Myers and the journalist Dianne Dumanoski published *Our Stolen Future,* examining the ways synthetic chemicals can mimic hormones and disrupt biological growth and development. The book was one of the most important scientific warnings of the modern era and prompted a government review of the "endocrine disrupting" potential of such chemicals. Incredibly, however, it contained not a single reference to PFCs. "We were not aware of them," Dr. Colborn told me. "These did not come on the radar until about six years ago."[5]

How could this have happened, scientists such as Colborn want to know. How could the toxicological significance of an *entire class* of industrial chemicals evade scientists for half a century, slipping under their radar and into our lives and bodies without an alarm bell sounding? "The [PFC] story is a public embarrassment to scientists and regulatory agencies around the world," said a University of Toronto researcher, Scott Mabury. "We know less about organofluorine compounds in the environment in the year 2000 than we knew about chlorinated hydrocarbons when Rachael Carson wrote her book in 1960. That is pathetic. It is pathetic that [such] a compound could reach such high concentrations in human blood tissue and nobody know that it is bio-accumulative and that it is very persistent."

As with fluoride, however, the problem has not been a lack of information on the health effects of PFCs. Instead, the problem is that the research data about PFC toxicity has not been shared with other scientists, federal regulators, or the public. DuPont, for example, has long known that its PFC chemicals pose a potential

health risk to workers and consumers. At least two company workers were killed and many others sickened while making Teflon during the war (see chapter 4). Following the wartime deaths, and fearing lawsuits from exposed employees and local citizens, the Manhattan Project's Dr. Harold Hodge from the University of Rochester visited DuPont's Haskell Laboratory in 1944 to discover what DuPont knew about the toxicity of its organofluorines.[6] Following Hodge's visit to DuPont, organofluorines were promptly given a high research priority by the Rochester team. The bomb-program toxicologists were warned that in some cases the toxicity of the organofluorines was worse than that of fluoride.[7] But for years, though Rochester scientists knew that organofluorines were a threat, almost nothing appeared in the medical literature about the toxicity of these important chemicals.

Instead, although health worries continued, the temptation to exploit PFCs for profit proved overwhelming. A 1955 DuPont company document entitled "Teflon—Health Hazards in Heating" notes that if Teflon is "heated above 400 degrees F (204 degrees C) . . . small quantities of harmful compounds are given off. . . . Consequently adequate ventilation must be provided at such temperatures. The concentrations of the volatile products necessary to produce harm have not been precisely established since it has not been possible to duplicate in animal tests the symptoms *observed in humans*" (emphasis added).[8] Nevertheless, on January 23, 1958, a Minneapolis lawyer, Harold D. Field, sought the medical advice of the Kettering Laboratory's Dr. Robert Kehoe. Field had a client who wanted to sell Teflon-lined pans in the United States, he explained. "DuPont has warned our client," Field wrote Kehoe, "that there may be some danger in the use of Teflon for this purpose." And later that year Dr. Albert Henne of Ohio State University contacted Kehoe. A Belgian company, Union Chimique Belge, also wanted to sell Teflon pots and pans in the United States, he told Kehoe. Henne had made some inquiries on the company's behalf.

"You may be interested to learn that . . . DuPont . . . seems to have started a 'rehabilitation' campaign for fluoride in the food business," Henne told Kehoe. He had friends in the legal department at Frigidaire (the unit of General Motors that sold Freon-filled refrigerators), Henne reported. They had assured him that "the sale of

coated skillets does not require the formal permission of the Food and Drug Administration." As a precaution, however, would Dr. Kehoe "act as a competent witness in case of a lawsuit?" Henne asked. Kehoe agreed.[9]

Where are the Atomic Energy Commission studies on the toxicity of PFCs? As the Teflon gold rush got under way and nonstick pans became a fixture in our kitchens, it was not until 1968—two decades after the Manhattan Project's Division of Pharmacology had made researching organofluorine toxicity a cold-war priority—that another University of Rochester fluoride scientist, Dr. Donald Taves, published the first data showing that organofluorines were accumulating in human blood.[10] Taves was a colleague of Dr. Harold Hodge, whose scientists at the University of Rochester had warned in 1946 that "organic fluorine compounds appear to be more toxic than the fluoride ion." And although Taves even measured PFCs in his own body, he nevertheless issued a firm reassurance as to the toxicological significance of his disconcerting discovery. "Other chemicals are usually not toxic in blood concentrations similar to those found here for organic fluorides."[11] (At the same time Taves was also collaborating with one of the nuclear industry's big fluorocarbon suppliers, 3M.)

Even today, retired in northern California, those Rochester reflexes remain strong. Dr. Taves agrees with the current safety reassurances from 3M and DuPont: because fluorine and carbon form such a stable bond, their presence in the human body in low doses is of little health concern. "I'm not so sure that they needed to take Scotchgard off the market," Taves said. "That is a very inert chemical."[12]

Similar safety assurances paved the way for the penetration of PFCs into our homes and industry. As a result, while the global PFC industry is now a multi-billion-dollar enterprise, scientists are playing catch-up—filling a fifty-year void in the published data on PFC toxicity. In her 1962 book, *Silent Spring,* scientist Rachel Carson explained how so-called persistent organic pollutants (POPS), such as DDT or PCBs, can pass through the food chain from fish and birds to humans.[13] In the same manner PFCs can accumulate in the human body. The battle over PFCs is shaping up as what may be the *Silent Spring* of the early twenty-first century.[14]

"It is the most important chemical pollutant issue I know of," says former 3M scientist Rich Purdy who, frustrated with 3M's lack of commitment to tackle the PFC issue, resigned in 1999 after nineteen years of work with the company.[15] "PFCs are having an adverse impact on wildlife and possibly humans right now," Purdy adds. "I think they rival the significance of the chemicals that Rachel Carson pointed to," adds a Michigan State scientist, Brad Upham. "I am personally puzzled as to why there is not much more concern about these compounds." (In an interview in September 2002 Upham told me that there had never been a formal request by the National Institutes of Health for scientists to submit proposals to study the toxic effects of PFCs.)

The strength of the carbonfluorine bond in PFCs means that these chemicals can last a very long time. Researchers fear that millions of people may be absorbing the fluorine compounds through treated carpeting, clothing, and furniture and from industrial waste from factories that produce Teflon and similar products. The PFC known as perfluorooctane sulfonate (PFOS), found in Scotchgard, "redefines the meaning of persistence," notes the University of Toronto's Scott A. Mabury. "It doesn't just last a long time; it likely lasts forever."[16]

The global reach of PFCs was revealed in the late 1990s, when 3M measured the level of PFC chemicals in blood samples taken from across the United States and in Europe. The company compared the results with older blood samples taken from Korean war veterans in the 1950s, predating 3M's introduction of Scotchgard. These samples, in comparison, were uncontaminated by the chemical.[17] Researchers from the University of Michigan have also found PFCs in mink, eagles, arctic polar bears, and albatrosses in the Pacific Ocean.[18] "The occurrence of [such chemicals in] albatrosses suggests the widespread distribution of [the chemical] in remote locations," the scientists reported.[19]

Perhaps most disturbingly, the environmental "sink"—or final resting place—of many PFCs is the blood, where they bind to protein and then accumulate in the liver and gallbladder.[20] (Unlike DDT or PCBs, which accumulate in body fat and soil, PFCs are resistant to fat or water. That is what makes them such good waterproofers and fabric protectors.) "It can be like global warming," Rich Purdy told

me. "What we produced twenty years ago, we still haven't harvested those effects yet. The peak hasn't hit."

The corporate suppression of information about the human health risks from PFCs was spelled out in internal documents of the DuPont Company only made public in 2002. According to medical studies and memos (reaching as far back as April 1981), DuPont researchers had recorded birth defects in children born to PFC workers at its Teflon plant in Parkersburg, West Virginia. The documents, which were posted on the Internet by the activist Environmental Working Group (EWG) in Washington, DC, revealed that the eyes of some DuPont workers' children were malformed and that there was widespread contamination of the local drinking-water supply by the PFC chemical used to make Teflon, perfluorooctanoic acid [PFOA].[21] Scandalously, and almost certainly illegally, DuPont never reported the birth defects nor the drinking-water contamination to the EPA or the local community.[22]

The EPA has grown increasingly concerned about PFC toxicity.[23] In May 2003 the agency formally asked DuPont to explain why the West Virginia drinking-water and birth-defect data had never been reported to the federal regulators. DuPont's attorney, Andrea V. Malinowski, wrote back, arguing that the birth defects could not "reliably" be linked to PFCs—and therefore did not require that the EPA be informed—and that the levels of PFCs in drinking water were too low to tell the public about.[24] That's a simple falsehood, claimed the EWG, which wants DuPont criminally punished for its actions.[25] The EWG says that DuPont clearly saw the possibility that PFC exposure was linked to the birth defects. Indeed, the company had first examined the health of worker's babies after receiving a 3M laboratory study in March 1981, which showed that PFOA caused eye defects in rats. According to a DuPont document, DuPont's review of children's health had been conducted to answer "a single question"—"does C-8 [PFOA] exposure cause abnormal children?"[26]

"We definitely do have concerns based on the toxicity data that has been submitted," noted Mary Dominiak, the chair of the fluorocarbon work group at EPA's Office of Pollution Prevention and Toxics. "I can't really go further than that because we are currently in the process of updating the hazard assessment."

The willingness of the EPA to review the human health risks from PFCs comes at the same time that federal regulators are also studying the basic issue of fluoride safety, promising to revisit the battlefields of a half-century of pitched conflict over water fluoridation and industrial fluoride pollution. On Tuesday, August 12, 2003, in a cramped room in the National Academy of Sciences building in Washington, DC, a newly formed panel of the National Research Council's (NRC) Committee on Toxicology listened to fluoride safety reassurances from the Centers for Disease Control. They also heard a lengthy criticism of existing safety standards from chemistry professor Paul Connett, a spokesperson for the activist lobbying group Fluoride Action Network. At issue is the EPA's official standard for how much fluoride should be permitted in the public water supply. In 1993, despite a hornet's nest of protest from some of its own scientists, the EPA decided to maintain the maximum contaminant level (MCL) at the level it had set in 1984—4 parts per million. Included in that decision, however, was the caveat that the official standard could be revised if additional scientific studies raised further doubts about fluoride safety. At the public hearing in Washington, Paul Connett pointed out that several new studies *had* been published since 1993, including Phyllis Mullenix's animal experiments at the Forsyth Dental Center, more recent studies from China that have found similar central-nervous-system effects in human beings, and an EPA study that reported that fluoridated water helped to carry aluminum into rats' brains, producing Alzheimer's-like lesions.[27]

According to longtime observers of America's fluoride wars, it is possible that a sea change in federal policy toward water fluoridation may be taking place. Harold Hodge was once the chairman of the NRC's Committee on Toxicology; as recently as 1993 the NRC fluoride panel had rubber-stamped his assurances of fluoride safety. But the new panel includes scientists and academics—Kathy Thiessen and Tom Webster, for example—who have all questioned the wisdom of water fluoridation; another member, Robert Isaacson, was part of the team that linked fluoride and aluminum to the Alzheimer-like lesions in rat brains. Bette Hileman, a reporter for *Chemical and Engineering News* who attended the hearing, stated that Paul Connett's presentation was even greeted with applause

from the panel. "This is highly unusual at an NAS/NRC meeting," Hileman remarked. "I would be very surprised if the new NAS report turns out to be a repeat of the one in 1993. The situation has changed."

But the fluoride lobby remains powerful. In the United Kingdom the Labour government of Prime Minister Tony Blair is promoting legislation that would give private water utilities immunity from fluoride-related lawsuits, in a bid to encourage them to fluoridate more communities. For these water companies, such immunity is a key legal requirement if they are to proceed with more fluoridation. In 1996 the toothpaste manufacturer Colgate made a £1000 payment to Sharon and Trevor Isaacs, of Highams Park, Essex, whose son Kevin suffered from dental fluorosis. Colgate acknowledged no liability for the dental damage, although there were hundreds of pending cases of British children with fluorosis-damaged teeth seeking compensation. The *Sunday Telegraph* newspaper reported that "Water companies have fought against fluoride amid fears of litigation."[28]

A great deal is at stake in the NRC review, certainly more than at first meets the eye. The pressure on the EPA to tighten safety standards for water will inevitably bring fresh scrutiny for industrial fluoride users. As Alcoa's Frank Seamans and his band of Fluorine Lawyers knew, the federal government's support of water fluoridation was extraordinarily helpful to corporate America, bolstering industry's legal defense against workers' and citizens' claims of industrial fluoride poisoning. The reverse is also true. If the government admits that fluoride in water is not as safe as they had once reassured us, then industry's fig leaf is jeopardized.

So will the EPA lower the boom on the industrial fluoride polluters? It still doesn't look good. The agency's August 2003 ruling on air pollution, which allows some 17,000 industrial facilities to escape the pollution-control requirements of the Clean Air Act, means that big fluoride polluters, such as coal-burning power stations and aluminum smelters, can continue to vent tens of thousands of tons of hydrogen fluoride gas over our homes and farms.

It is America's industrial workers that most need the protection of regulators. The 1970 Occupational Safety and Health Act guarantees citizens a safe workplace. But eight years before that law was

signed, the Kettering dog study showed that inhaled fluoride causes lung and lymph-node damage. The recent unearthing of that long-buried study prompted two leading toxicologists, Robert Phalen and Phyllis Mullenix, to claim that the current standard for occupational exposure to fluoride is almost certainly too high. And with the recent report that emphysema—a key injury in Robert Kehoe's fluoride-breathing dogs—is much more prevalent among industrial workers than once imagined, the inability of federal standard-setters to locate a *single* animal study to justify their current safety standard is especially concerning.[29]

Industry will in all likelihood fight any revision to the water fluoride safety standard. This fierce desire to maintain the existing permissive standards was suggested by the presence of several representatives from the EPA's pesticide division at the NRC public meeting. Dow Chemical is currently using sulfuryl fluoride as a pest fumigant to replace the ozone-depleting methyl bromide. If the fluoride safety standard for water is toughened, Dow's efforts to lobby the EPA to allow increased fluoride residues on our fruit and vegetables will almost certainly be challenged.

As Paul Connett notes, replacing methyl bromide with sulfuryl fluoride is a dubious proposition. "In animal studies it damages the white matter in the brain," Connnet explains. "So Dow is proposing to replace a chemical that causes holes in the ozone layer with one that causes holes in the brain! Some trade-off."[30]