The Fluoride Deception

CHRISTOPHER BRYSON

SEVEN STORIES PRESS
New York • London • Toronto • Melbourne

Table of Contents

The Fluoride Deception

CHRISTOPHER BRYSON

For my father

Toute entreprise humaine, fût-elle industrielle,
est susceptible de perfectionnement!

Inscription on memorial to the sixty dead of the 1930 Meuse Valley disaster

It is not just a mistake for public health agencies to cooperate and collaborate with industries investigating and deciding whether public health is endangered—it is a direct abrogation of the duties and responsibilities of those public health organizations.

Scientist Clair Patterson to the U.S. Senate, 1966[1]

If you ain't thinking about Man, God and Law, you ain't thinking about nothin'.

Joe Strummer (1952-2002)

Foreword

THEO COLBORN

THE QUESTION OF whether fluoride is or is not an essential element is debatable. In other words, is the element, fluorine, required for normal growth and reproduction? On one hand there appears to be a narrow range of topical exposure in which it might prevent cavities. But if exposure is too high, it causes serious health problems. And could an individual who is totally deprived of fluoride from conception through adulthood survive? Definitive research to resolve these questions has never appeared in the public record or in peer-reviewed journals. It is important to keep this fact in mind as you read this book.

Chris Bryson informs us that fluorine is, indeed, an essential element in the production of the atom bomb, and there is good reason to believe that fluoridated drinking water and toothpaste—and the development of the atom bomb—are closely related. This claim sounded pretty far-fetched to me, and consequently I was extremely skeptical about the connection when I started reading the book. Bryson writes with the skill of a top-selling novelist, but it was *not* his convincing storytelling that made me finish the book. It was the haunting message that possibly here again was another therapeutic agent, fluoride, that had not been thoroughly studied before it was foisted on the public as a panacea to protect or improve health. Bryson reveals that the safety of fluoride became a firmly established paradigm based on incomplete knowledge. The correct questions were never asked (or never answered when they were asked), thus giving birth to false or bottomless assumptions that fluoride was therapeutic and safe. Certainly, the evidence Bryson unearthed in this book begs for immediate attention by those responsible for public health.

As the story unfolds, Bryson weaves pieces of what at first appears to be totally unrelated evidence into a tapestry of intrigue, greed, collusion, personal aggrandizement, corporate and government cover-up, and U.S. Public Health Service (USPHS) mistakes. While reading the book, I kept thinking back to 1950, three years after I got my BS degree in Pharmacy and the year I gave birth to my first child. Fluoride came on the market packaged in pediatric vitamin drops for infants. Mothers left the hospital with their new babies in their arms and prescriptions in their hands from their dismissing physicians for these fluoride-laced drops. About that time communities around the country began to add fluoride to their drinking water. The promised benefits of fluoride were so positive that my dentist friends began to wish that they had chosen dermatology instead of dentistry. At that same time pregnant women were being given a pharmaceutical, diethylstilbestrol (DES), to prevent miscarriages, as well as DES-laced prescription vitamins especially designed for pregnant women to produce big, fat, healthy babies. I felt good when I dispensed the fluoride and DES prescriptions—*they were products designed to prevent health problems rather than treat them*. Now I can only wonder how many children were harmed because I and others like me took the word of the National Institutes of Health (NIH), the USPHS, and the major pharmaceutical companies producing these products. We were caught up in the spin. We were blind to the corporate hubris and were swept along with the blissful enthusiasm that accompanies every new advance in modern technology and medicine.

The hazards posed by prenatal exposure to DES surfaced a lot sooner than those posed by fluoride. And although by 1958 it was discovered that DES caused a rare vaginal cancer that until that time had been found only in postmenopausal women, its use during pregnancy was not banned until 1971—thirteen years later. Even this year, 2003, new discoveries are being reported about the impact on health in the sons and daughters of the DES mothers, and now in their grandchildren. It is estimated that in the United States alone there are ten million daughters and sons. In comparison to DES, where exposure could be traced through prescription records, the extent of exposure to fluorides through drinking water, dental products, vitamins, and as Bryson points out, through Teflon, Scotchgard, Stainmaster, and other industrial and agricultural fluorinated products is practically unmeasurable.

Certainly the evidence Bryson presents in this book should cause those charged with protecting public health to demand answers about the developmental, reproductive, and functional role of fluorine in all living organisms. A lack of data on the safety of a product is not proof of safety. Evidence has only recently surfaced that prenatal exposure to certain fluorinated chemicals is dangerous, often fatal at high doses, and that—even at extremely low levels—such exposure can undermine the development of the brain, the thyroid, and the metabolic system. This evidence surfaced because industrial fluorine chemicals were suddenly being discovered in human and wildlife tissue everywhere they were looked for on earth. As a result, the U.S. Environmental Protection Agency (EPA) began to press the manufacturers of these products for data on their safety. It is no wonder that such chemicals never made it on the list of known endocrine disrupters, chemicals that undermine development and function. The studies were never done, or if they were, they were not available to the public. It is time that these chemicals, at the cumulative concentrations they are found in the environment, be tested thoroughly for their developmental, reproductive, and endocrine effects.

Whether or not Bryson's nuclear-bomb connection is ever confirmed without a doubt, this book demonstrates that there is still much that needs to be considered about the continued use of fluorine in future production and technology. The nuclear product that required the use of fluorine ultimately killed 65,000 people outright in one sortie over Japan. The actual number of others since then and in generations to come who will have had their health insidiously undermined by artificial exposure to fluorides and other fluorine chemicals with half-lives estimated in geologic time may well exceed that of the atom bomb victims millions and millions of times over.

Dr. Theo Colborn, coauthor of *Our Stolen Future: Are We Threatening Our Fertility, Intelligence, and Survival? A Scientific Detective Story* (1996)

Note on Terminology

THE TERMS *fluorine* and *fluoride* should not be confused in a book about chemical toxicity. Fluorine is an element, one of our planet's building blocks, an especially tiny atom that sits at the summit of the periodic table. Its lordly location denotes an unmatched chemical potency that is a consequence of its size and structure. The nine positively charged protons at the atom's core get little protection from a skimpy miniskirt of electrons. As a result, fluorine atoms are unbalanced and dangerous predators, snatching electrons from other elements to relieve their core tension. (A ravenous hunger for electrons explains why fluorine cuts through steel like butter, burns asbestos, and reacts violently with most organic material.)[1]

Mercifully, Mother Nature keeps fluorine under lock and key. Because of its extreme reactivity, fluorine is usually bound with other elements. These compounds are known as salts, or *fluorides*, the same stuff that they put in toothpaste. Yet the chemical potency of fluorides is also dramatic. Armed with a captured electron, the toxicity of the negatively charged fluoride ion now comes, in part, from its tiny size. (*Ionic* means having captured or surrendered an electron). Like a midget submarine in a harbor full of battleships, fluoride ions can get close to big molecules—like proteins or DNA—where their negative charge packs a mighty wallop that can wreak havoc, forming powerful bonds with hydrogen, and interfering with the normal fabric of such biological molecules.[2]

However—and please stay with me here, I *promise* it gets easier—somewhat confusingly, the words *fluorine* and *fluoride* are sometimes used interchangeably. A fluoride compound is often referred to, generically, as fluorine. (For example, the Fluorine Lawyers Committee was a group of corporate attorneys concerned about the medical and legal dangers from a great range of different industrial "fluorides" spilling from company smokestacks.)

In these pages I've tried to be clear when I'm referring to the element fluorine or to a compound, a fluoride. And because different fluoride compounds often have unique toxicities, where relevant or possible, I have also given the compound's specific name. Mostly, however, for simplicity's sake, I have followed convention and used the shorthand *fluoride* when referring to the element and its multiple manifestations, a procedure approved and used by the U.S. National Academy of Sciences.[3]

Acknowledgments

This book owes a debt of gratitude to many. First is my wife, Molly, whose love and encouragement pushed me to the starting line and carried me across the finish. My first encounter with fluoride came as a BBC radio journalist working in New York in 1993, when I was asked to find an “American angle” on water fluoridation. Ralph Nader put me in touch with scientists at the U.S. Environmental Protection Agency who opposed fluoridation.[1] As I followed that story, I met the medical writer Joel Griffiths. His investigative article “Fluoride: Commie Plot or Capitalist Ploy” in the fall 1992 issue of the magazine *Covert Action Information Bulletin* is a masterful and detailed account of how fluoride is primarily an industrial and environmental story. Griffiths reported how vested economic interests were behind the earliest suggestions that fluoride be added to water, while those same interests for decades had assiduously suppressed information about fluoride’s destructive effects on health and environment. Griffiths’s paradigm-shifting story was my starting gun and, as my Manhattan neighbor, I leant heavily on his reporting, interviews, documents, interpretation and the gentle friendship of him and his wife Barbara as I wrote this book. Librarians are foot soldiers of democracy, and a legion of them sacked archives for me from Tennessee to Washington State and from Denmark to London. Everywhere I was met with eager help digging out dusty files and courteous answers to the most foolish of questions. Special thanks to my favorite Metallica fan, Billie Broaddus, at the University of Cincinnati Medical Heritage Center, Marjorie Ciarlante at the National Archives in Washington, DC, and Donald Jerne at the Danish National Library of Science and Medicine. The book's spine is the authority of the many workers, scientists, and public officials who gave so freely of their time. Particular gratitude to Albert Burgstahler of the University of Kansas, the EPA's J. William Hirzy, Robert J. Carton, Phyllis J. Mullenix, Kathleen M. Thiessen of SENES Oak Ridge Inc., and Robert F. Phalen of the University of California at Irvine, who each spent long hours reviewing documents and medical studies for me.

I had the good fortune to serve an apprenticeship in the 1980s with the late Jonathan Kwitny, one of the nation's top investigative reporters. From his hospital bed, weak from radiation treatment, he encouraged me. "This is your book," he said. I was helped with financial support from the Fund for Investigative Journalism, Inc., and the Institute for Public Affairs. A bouquet to Dan Simon at Seven Stories Press, who clapped his hands in glee when told he'd be taking on the great industrial trusts of America. Special thanks to Lexy Bloom and Ruth Hein for their critical and conscientious editing; to George Mürer, Anna Lui, Chris Peterson, and India Amos for wrestling this octopus to the printer; and to the entire staff at Seven Stories Press for their passion and commitment.

Many helped in myriad other ways. This book is theirs, too. Gwen Jaworzyn, Janet Michel, Bette Hileman, *USA Today* and Peter Eisler, George Mavridis, Felicity Bryson and Vincent Gerin, Ruth Miller at the Donora Historical Society, Anne-Lise Gotzsche, Barbara Griffiths, Anthony and Nancy Thompson and family, Basil and Anne Henderson, Joan-Ellen and Alex Zucker, Nina and David Altschiller, Bill and Janney Murtha, Tom Webster, Naomi Flack, Ken Case, Bob Woffinden, Traude Sadtler, Gordon Thompson, Clifford and Russ Honicker, Jacqueline O. Kittrell, Ellie Rudolph, Robert Hall, Martha Bevis, John Marks, Chris Trepal, Carol Patton, Gar Smith at *Earth Island Journal*, Lennart Krook, Danny Moses at Sierra Club

Books, Andreas Schuld, Erwin Rose and family, Roberta Baskin, the Connett family, Colin Beavan, Sam Roe, Karin and Hans Hendrik Roholm, Eleanor Krinsky, Allen Kline, Bill and Gladys Shempp (who put me up in their home in Donora one night), Elizabeth Ramsay, Lynne Page Snyder, and Peter Meiers, whom I never met nor spoke with but whose splendid research led me to the papers of Charles F. Kettering.

Thank you all.

Introduction

A Clear and Present Danger

Warning: Keep out of reach of children under 6 years of age. If you accidentally swallow more than used for brushing, get medical help or contact a Poison Control Center right away.

NEXT TIME YOU confront yourself in the bathroom mirror, mouth full of foam, take another look at that toothpaste tube. Most of us associate fluoride with the humdrum issue of better teeth and the promised fewer visits to the dentist. Yet the story of how fluoride was added to our toothpaste and drinking water is an extraordinary, almost fantastic tale. The plot includes some of the most spectacular events in human affairs—the explosion of the Hiroshima atomic bomb, for example. Many of the principal characters are larger than life, such as the "father of public relations" Edward L. Bernays, Sigmund Freud's nephew, who was until now more famous for his scheme to persuade women to smoke cigarettes.[1] And the twists and turns of the fluoride story are propelled by nothing less than the often grim requirements of accumulating power in the industrial era—the same raw power that is at the beating heart of the American Century.

Fluoride lies at the elemental core of some of the greatest fortunes that the world has ever seen, the almost unimaginable wealth of the Mellons of Pittsburgh and the DuPonts of Delaware. And no wonder the warning on the toothpaste tube is so dramatic. The same potent chemical that is used to enrich uranium for nuclear weapons, to prepare Sarin nerve gas, and to wrestle molten steel and aluminum from the earth's ore is what we give to our children first thing in the morning and last thing at night, flavored with peppermint, strawberry, or bubble gum.

Fluoride is so muscular a chemical that it has become a lifeblood of modern industry, pumped hotly each day through innumerable factories, refineries, and mills. Fluoride is used to produce high-octane gasoline; to smelt such key metals as aluminum, steel, and beryllium; to enrich uranium; to make computer circuit boards, pesticides, ski wax, refrigerant gases, Teflon plastic, carpets, waterproof clothing, etched glass, bricks and ceramics, and numerous drugs, such as Prozac and Cipro.

Fluoride's use in dentistry is a sideshow by comparison. But its use in dentistry helps industry, too. How does it work? Call it elemental public relations. Fluoride is so potent a chemical that it's also a grave environmental hazard and a potential workplace poison. So, for the industry-sponsored scientists who first promoted fluoride's use in dentistry, linking the chemical to better teeth and stoutly insisting that, in low doses, it had no other health effect helped to change fluoride's image from poison to panacea, deflecting attention from the injury that factory fluoride pollution has long wreaked on workers, citizens, and nature.

Hard to swallow? Maybe not. The face-lift performed on fluoride more than fifty years ago has fooled a lot of people. Instead of conjuring up the image of a crippled worker or a poisoned forest, we see smiling children. Fluoride's ugly side has almost entirely escaped the public gaze. Historians have failed to record that fluoride pollution was the biggest single legal worry facing the atomic-bomb program following World War II. Environmentalists are often unaware that since World War II, fluoride has been the most damaging poison spilling from factory smokestacks and was, at one point during the cold war, blamed for more damage claims against industry than *all twenty other major air pollutants combined*.[2] And it was fluoride that may have been primarily responsible for the most notorious air pollution disaster in U.S. history—the 1948 Halloween nightmare that devastated the mill town of Donora, Pennsylvania—which jump-started the U.S. environmental movement.[3]

It's the same story today: more happy faces. Yet we are exposed to fluoride from more sources than ever. We consume the chemical from water and toothpaste, as well as from processed foods made with fluoridated water and fluoride-containing chemicals. We are exposed to fluorine chemicals from often-unrecognized sources, such as agricultural pesticides, stain-resistant carpets, fluorinated drugs, and such packaging as microwavable popcorn bags and hamburger wrappers, in addition to industrial air pollution and the fumes and dust inhaled by many workers inside their factories.

Fluoride's double-fisted trait of bringing out the worst in other chemicals makes it especially bad company. While a common air pollutant, hydrogen fluoride, is many times more toxic than better-known air pollution villains, such as sulfur dioxide or ozone, it "synergistically" boosts the toxicity of *these* pollutants as well.[4] Does fluoride added to our drinking water similarly increase the toxicity of the lead, arsenic, and other pollutants that are routinely found in our water supply? As we shall see, getting answers to such questions from the federal government, even after fifty years of endorsing water fluoridation, can prove impossible.

By the mid-1930s European scientists had already linked fluoride to a range of illnesses, including breathing problems, central-nervous-system disorders, and especially an array of arthritis-like musculoskeletal problems.[5] But during the cold war, in one of the greatest medical vanishing acts of the twentieth century, fluoride was systematically removed from public association with ill health by researchers funded by the U.S. military and big corporations. In Europe excess exposure to fluoride produced a medical condition described as "poker back" or "crippling skeletal fluorosis" among factory workers. But the chemical somehow behaved differently when it crossed the Atlantic, the industry-funded researchers implied, failing to produce such disability in the United States.[6] It was a deceit, as we shall see: scientific fraud on a grand and global scale; a lawyerly ruse to escape liability for widespread worker injury; a courtroom hustle made possible and perpetuated by the suppression of medical evidence and by occasional perjury.

Your history is all mixed up, say supporters of water fluoridation. The story of how fluoride was added to our toothpaste and water is a separate history, unrelated to fluoride's use in industry, they maintain. But there is only one story, not two. The tale of the dental "wonder chemical" and the mostly secret account of how industry and the U.S. military helped to create and polish that public image are braided too closely to distinguish between them. The stories merge completely in the conduct of two of the most senior American scientists who led the promotion of water fluoridation in the 1940s and 1950s, Dr. Harold Carpenter Hodge and Dr. Robert Arthur Kehoe.

Don't blame the dentists. They were taught that fluoride is good for teeth. Few realize that Dr. Hodge, the nation's leading fluoride researcher who trained a generation of dental school deans in the 1950s and 1960s, was the senior wartime toxicologist for the Manhattan Project. There he helped choreograph the notorious human radiation experiments in which hospital patients were injected with plutonium and uranium—without their knowledge or consent—in order to study the toxicity of those chemicals in humans. Hodge was similarly charged with studying fluoride toxicity. Building the world's first atomic bomb had required gargantuan amounts of fluoride. So, for example, on behalf of the bomb makers he covertly monitored one of the nation's first public water fluoridation experiments. While the citizens of Newburgh, New York, were told that fluoride would reduce cavities in their children, secretly blood and tissue samples from residents were sent to his atomic laboratory for study.[7]

Some dentists are unaware that much of the fluoride added to drinking water today in the United States is actually an industrial waste, "scrubbed" from the smokestacks of Florida phosphate fertilizer mills to prevent it from damaging livestock and crops in the surrounding countryside. In a sweetheart deal these phosphate companies are spared the expense of disposing of this "fluosilicic acid" in a toxic waste dump. Instead, the acid is sold to municipalities, shipped in rubber-lined tanker trucks to reservoirs across North America and injected into drinking water for the reduction of cavities in children. (So toxic are the contents of the fluoride trucks that in the aftermath of the September 11, 2001, terrorist attack, authorities were alerted to keep a watchful eye on road shipments of the children's tooth-decay reducer.)[8]

"I had no idea where the fluoride was coming from until the antifluoridationists pointed it out to me," Dr. Hardy Limeback, the head of Preventative Dentistry at the University of Toronto, Canada, and a former leading fluoridation supporter, told me. "I said, 'You have got to be wrong. That is not possible!'"

Those same phosphate manufacturers were members of an influential group of industries that sponsored Dr. Robert Kehoe's fluoride research at the University of Cincinnati during the 1940s and 1950s. Kehoe is better known today for his career-long defense of the safety of adding lead to gasoline (now discredited). But he was also a leading figure reassuring citizens and scientists of the safety of industrial fluoride and water fluoridation, while burying information about the chemical's toxic effects and privately sharing doubts with his corporate sponsors about the safety of even tiny amounts of the chemical.[9]

Not surprisingly, peering behind the fifty-year-old facade of smiling children with rows of picket-fence-white teeth is difficult. Industry is reluctant to have its monument to fluoride safety blackened or its role in dental mythmaking explored. Several of the archives I visited had gaping holes or missing documents, and some were closed entirely. And many scientists are reluctant to speak critically about fluoride—mindful of the fate of researchers who have questioned the government line. Scientists have been fired for their refusal to back down from their questions about the safety of fluoride, blackballed by industry, or smeared by propagandists hired by the U.S. Public Health Service and the American Dental Association. [10] "Bodies litter the field," one senior dental researcher told me when he learned that I was writing a book on fluoride.

Myths are powerful things. Mention of fluoride evokes a skeptically cocked eyebrow from liberals and conservatives alike and an almost reflexive mention of the 1964 Stanley Kubrick film *Dr. Strangelove*. The hilarious portrayal of General Jack D. Ripper as a berserk militarist obsessed with Communists adding fluoride to the nation's water became a cultural icon of the cold war—and perhaps the movie's most famous scene. (Today Nile Southern, the son of *Dr. Strangelove*'s screenwriter, Terry Southern, remarks that the news that U.S. military and industrial interests—not

Communists—promoted water fluoridation is “just shocking. Terry and Stanley [Kubrick] would have been horrified by it.”)[11]

The media caricature was largely false. The national grassroots struggle against water fluoridation was a precursor of today’s environmental movement, with multicolored hues of political affiliation. It was led by veteran scientists with distinguished careers safeguarding public health, including the doctor who warned the nation about the dangers of cigarette smoking and the risk from allergic reaction to penicillin.[12] Yet instead of being seen as medical pioneers and minutemen, warning of the encroachment of industrial poisons, antifluoridationists are portrayed as unscientific and isolationist—the modern equivalent of believing that the earth is flat.

It is the U.S. medical establishment that is out on a limb, say critics. Adding to water a chemical so toxic that it was once used as rat poison was a uniquely American idea and is, increasingly, a lone American practice. Most European countries do not add fluoride to their water. Several nations have long since discontinued the practice, doubting its safety and worth.[13]

Fluoride may help teeth, but the evidence is not overwhelming. Although rates of dental decay have fallen significantly in the United States since the 1940s, similar improvements have been seen in countries where fluoride is not added to the water. Improved dental care, good nutrition, and the use of antibiotics may explain the parallel improvement. A largely sympathetic official review of fluoridation by the British government in 2000 found that most studies of the effectiveness of fluoridated water were of "moderate" quality and that water fluoridation may be responsible for 15 percent fewer cavities.[14] That's a far cry from the 65 percent reductions promised by the early promoters of fluoride. With revelations that such health problems as central nervous system effects, arthritis, and the risk of bone cancer were minimized or concealed entirely from the public by early promoters of fluoride, the possible benefit of a handful of better teeth might not be worth running the risk. "How many cavities would have to be saved to justify the death of one man from osteosarcoma?" asked the late Dr. John Colquhoun, the former chief dental officer of Auckland, New Zealand, and a fluoride promoter turned critic.[15]

"I did not realize the toxicity of fluoride," said Dr. Limeback, the Canadian. "I had taken the word of the public health dentists, the public health physicians, the USPHS, the USCDC, the ADA, the CDA [Canadian Dental Association] that fluoride was safe and effective without actually investigating it myself."

Even the theory of how fluoride works has changed. The CDC no longer argues that fluoride absorbed from the stomach via drinking water helps teeth. Instead, the argument goes, fluoride strikes at dental decay from *outside* the tooth, or "topically," where, among other effects, it attacks the enzymes in cavity-causing bacteria. Drinking fluoridated water is still important, according to the CDC, because it bathes the teeth in fluoride-enhanced saliva—a cost-effective way of reaching poorer families who may not have a balanced diet, access to a dentist, or the regular habit of brushing with fluoride toothpaste.[16]

But swallowing treated water allows fluoride into our bones and blood, where it may be harmful to other parts of the body, say critics. If fluoride can kill enzymes in tooth bacteria, its potentially crippling effects on other enzymes—the vital chemical catalysts that regulate much biological activity—must be considered .[17]

"When I investigated [such questions] I said, 'This is crazy. Let's take it out of the water because it is harming so many people—[not] simply the dental fluorosis [the white mottling on teeth caused by fluoride], but now we are seeing bone problems and possibly cancer and thyroid problems. If you are really targeting the poor people, let's give toothpaste out at the food banks. Do something other than fluoridate the water supply,'" said Dr. Limeback. "Then [the fluoride promoters] kept saying, 'Well, it is cost effective.' That is a load of crap-it is cost effective because they are using toxic waste, for crying out loud!"

History tells us that overturning myths is rarely easy. But we have been down this path before. The fluoride story is similar to the fables about lead, tobacco, and asbestos, in which medical accomplices helped industry to hide the truth about these substances for generations. Fluoride workers share a tragic fate with the souls who breathed beryllium, uranium, and silica in the workplace. Endless studies that assured workers that their factories and mines were safe concealed the simple truth that thousands of people were being poisoned and dying painful early deaths from these chemicals. So if this tale of how fluoride's public image was privately laundered sounds eerily familiar, maybe it's because the very same professionals and institutions who told us that fluoride was safe said much the same about lead, asbestos, and DDT or persuaded us to smoke more tobacco.

Lulled by half a century of reassurances from supporters of fluoride in the public health establishment, many doctors today have no idea of the symptoms of fluoride poisoning. A silent killer may stalk us in our ignorance. "There is a black hole out there, in terms of the public and scientific knowledge," says former industry toxicologist Dr. Phyllis Mullenix. "There is really no public health issue that could impact a bigger population. I don't think there is an element of this society that is not impacted by fluoride. It is very far-reaching and it is very disturbing."

Fifty years after the U.S. Public Health Service abruptly reversed course during the darkest days of the cold war—and endorsed artificial water fluoridation—it is time to recognize the folly, hubris, and secret agendas that have shackled us too long, poisoning our water, choking our air, and crippling workers. It is time, as the Quakers ask in life, to speak truth to power. Good science can sharpen the tools for change, but it will be public opinion and citizen action that strike those shackles free.

Major Figures in the Fluoride Story

EDWARD L . BERNAYS . A propagandist and the self-styled father of public relations, Bernays was Sigmund Freud's nephew. Among his clients were the U.S. military, Alcoa, Procter and Gamble, and Allied Signal. On behalf of big tobacco companies he persuaded American women to smoke cigarettes. He also promoted water fluoridation, consulting on strategy for the National Institute of Dental Research.

GERALDJUDY COX . A researcher at the Mellon Institute in the 1930s, where he held a fellowship from the Aluminum Company of America. Following Frary's (see below) suggestion, Cox reported that fluoride gave rats cavity-resistant teeth and in 1939 made the first public proposal to add fluoride to public water supplies.

HENRY TRENDLEY DEAN. The U.S. Public Health Service researcher who studied dental fluorosis in areas of the United States where fluoride occurred naturally in the water supply. His "fluorinecaries" hypothesis suggested that fluoride made teeth cavity-resistant but also caused unsightly dental mottling. Worried about toxicity, Dean opposed adding fluoride to water in Newburgh, New York, the site of the nation's first-planned water fluoridation experiment. In 1948 Dean became the first director of the National Institute of Dental Research (NIDR) and, in 1953, a top official of the American Dental Association.

OSCARR. EWING. A top Wall Street lawyer for the Aluminum Company of America. As Federal Security Agency administrator for the Truman administration with jurisdiction over the Public Health Service, it was Ewing who, in 1950, endorsed public water fluoridation for the United States.

FRANCIS COWLES FRARY. As Director of Research at the Aluminum Company of America from 1918, Frary was one of the most powerful science bureaucrats in the United States and grappled with the issue of fluoride emissions from aluminum smelters. It was Frary who made early suggestions to Gerald Cox, a researcher at the Mellon Institute, that fluoride might make strong teeth.

GENERAL LESLIER. GROVES . Head of the U.S. Army Corps of Engineers' Manhattan Project to build the world's first atomic bomb.

HAROLD CARPENTER HODGE. A biochemist and toxicologist at the University of Rochester who investigated fluoride for the U.S. Army's Manhattan Project, where he also supervised experiments in which unsuspecting hospital patients were injected with uranium and plutonium. After the war Hodge chaired the National Research Council's Committee on Toxicology and became the leading scientific promoter of water fluoridation in the United States during the cold war.

DUDLEY A . IRWIN. Alcoa's medical director who helped oversee Robert Kehoe's fluoride research at the Kettering Laboratory, and who met personally with top fluoride researchers at the National Institute of Dental Research (NIDR) following the verdict in the Martin air-pollution trial.

ROBERT A. KEHOE. As the Director of the Kettering Laboratory of Applied Physiology at the University of Cincinnati, Kehoe was the leading defender in the United States of the safety of leaded gasoline. Guided by a group of corporate attorneys known as the Fluorine Lawyers Committee, Kehoe similarly defended fluoride on behalf of a group of corporations that included DuPont, Alcoa, and U.S. Steel, all of which faced lawsuits for industrial fluoride pollution.

EDWARD J . LARGENT. A researcher at the Kettering Laboratory who defended corporations accused of fluoride pollution and spent a career negating the fluoride warnings of the Danish scientist Kaj Roholm. Largent exposed his wife and son to hydrogen fluoride in a laboratory gas chamber.

NICHOLAS C . LEONE. The head of medical investigations at the federal government's NIDR who was in close communication with industry's Fluorine Lawyers and who, following the 1955 Martin verdict, met with Alcoa's Dudley Irwin and the Kettering Laboratory's Robert Kehoe to discuss how government water fluoridation safety studies could help industry.

WILLIAM J . MARCUS. A senior toxicologist in the EPA's Office of Drinking Water. In 1992, after he protested what he described as the systematic downgrading of the results of the government's study of cancer and fluoride, he was fired. A federal judge later ruled that he had been fired because of his scientific opinions on fluoride and ordered him reinstated.

PAUL AND VERLA MARTIN. Oregon farmers who were poisoned by fluoride from a Reynolds Metals aluminum plant. Their precedent-setting court victory in 1955 sparked emergency meetings between fluoride industry representatives and senior officials from the National Institute of Dental Research and launched a crash program of laboratory experiments at the Kettering Laboratory to prove industrial fluoride pollution "safe."

PHYLLIS J . MULLENIX. A leading neurotoxicologist hired by the Forsyth Dental Center in Boston to investigate the toxicity of materials used in dentistry. In 1994, after her research indicated that fluoride was neurotoxic, she was fired.

KAJ EL ROHOLM. The Danish scientist who in 1937 published the book *Fluorine Intoxication*, an encyclopedic study of fluoride pollution and poisoning. He opposed giving fluoride to children.

PHILIP SADTLER. The third-generation son of a venerable Philadelphia family of chemists, Sadtler gave expert testimony during the 1940s and 1950s on behalf of farmers and citizens who claimed that they had been poisoned by industrial fluoride pollution. He blamed fluoride for the most notorious air pollution disaster in U.S. history, during which two dozen people were killed and several thousand were injured in Donora, Pennsylvania, over the Halloween weekend in 1948.

FRANK L . SEAMANS. A top lawyer for Alcoa, Seamans was also head of the group of senior attorneys known as the Fluorine Lawyers Committee, which represented big corporations in cases of alleged industrial fluoride pollution.

GEORGE L . WALDBOTT. A doctor and scientist and a leading expert on the health effects of environmental pollutants, Waldbott's research in the 1950s and 1960s on his own patients indicated that many people were uniquely sensitive to very small doses of fluoride. He founded the International Society for Fluoride Research and was a leader of the international and domestic opposition to water fluoridation.

COLONEL STAFFORD L . WARREN. Head of the Manhattan Project's Medical Section.

EDWARD RAY WEIDLEIN. Director of the Mellon Institute, where Cox carried out his studies.

1

Through the Looking Glass

At the children's entrance to the prestigious Forsyth Dental Center in Boston, there is a bronze mural from a scene in Alice in Wonderland. *The mural makes scientist Phyllis Mullenix laugh. One spring morning, when she was the head of the toxicology department at Forsyth, she walked into the ornate and marbled building and, like Alice, stepped through the looking glass. That same day in her Forsyth laboratory she made a startling discovery and tumbled into a bizarre wonderland where almost no one was who they had once appeared to be and nothing in the scientist's life would ever be the same again.*

AS SHE DROVE alongside the Charles River in the bright August sunshine of 1982 for her first day of work at the Forsyth Dental Center in Boston, toxicologist Phyllis Mullenix was smiling. She and her husband Rick had recently had their second daughter. Her new job promised career stability and with it, the realization of a professional dream.

Since her days as a graduate student Mullenix had been exploring new methods for studying the possible harmful effects of small doses of chemicals. By 1982 Dr. Mullenix was a national leader in the young science of neurotoxicology, measuring how such chemicals affected the brain and central nervous system. She and a team of researchers were developing a bold new technology to perform those difficult measurements more accurately and more quickly than ever before.

The system was called the Computer Pattern Recognition System. It used cameras to record changes in the "pattern" of behavior of laboratory animals that had been given tiny amounts of toxic chemicals. Computers then rapidly analyzed the data. By detecting how the animals' behavior differed from that of similar "control" animals—that were not given the toxic agent—scientists were able to measure or "quantify" the extent to which a chemical affected the animals' central nervous system.

Previous such efforts had relied on subjective guesswork as to the severity of the chemical's toxic effect or on laborious and time-consuming efforts to quantify the changes the chemical made in behavior. The speed of the computers and the accuracy of the camera measurements in the Mullenix system, however, could potentially revolutionize the study of toxic chemicals.

As her car flew along the Charles River that summer morning in 1982, Mullenix knew that her new job and the support of the prestigious Forsyth Dental Center would finally allow her to complete the work on her new system.

Mullenix had caught the eye of Forsyth's director, John "Jack" Hein, some years earlier. He had attended one of her seminars at the Harvard Medical School, where she was a faculty member in the Department of Psychiatry. He had sat in the audience, dazzled, his mind racing. Hein remembers a "very bright" woman describing a revolutionary new technology, which he believed had the potential for transforming the science of neurotoxicology. "She had the world by the tail," said Hein. "There is nothing more exciting than a new methodology."[1]

Jack Hein wanted Mullenix to bring her new technology to Forsyth and to set up a modern toxicology laboratory. It would be the first such dental toxicology center in the country. Many powerful chemicals are routinely employed in a dentist's office, such as mercury, high-tensile plastics, anesthetics, and filling amalgams. Hein knew that an investigation of the toxicity of some of these materials was overdue.

The Forsyth director's boyish enthusiasm helped to sell Mullenix on the move. "I was very impressed with Dr. Hein," she said. "He was like a kid in a candy store. He couldn't wait for us to use the new methodology and apply it to some of the materials dentists work with."

Phyllis Mullenix's transfer to Forsyth was a move to one of Boston's most prestigious medical centers. The Forsyth Dental Infirmary for Children was established in 1910 to provide free dental care to Boston's poor children. By 1982, when Dr. Mullenix accepted Jack Hein's invitation, the renamed Forsyth Dental Center was affiliated with Harvard Medical School and had become one of the best-known centers for dental research in the world.

At the helm was Forsyth's director, Jack Hein, a well-known figure in American dental research. Hein had attended the University of Rochester in the 1950s, and there he had helped to develop the fluoride compound sodium monofluorophosphate (MFP). Colgate soon added MFP to its toothpaste, and Jack Hein became the company's dental director in 1955.[2] When he came to Forsyth in 1962, Hein was part of the new order in reshaping American dentistry—a changing of the guard then taking place in many dental schools and research centers.[3] Like Jack Hein, the new generation of leaders was uniform in its support of fluoride's use in dentistry.[4]

Forsyth had read the tea leaves well. While a previous Forsyth director, Veikko O. Hurme, had been an outspoken opponent of adding fluoride to public water supplies, Jack Hein's support came at the same time that Colgate poured cash into new facilities and fluoride research at Forsyth.[5] Additional funds came from research grants from other private corporations and from the federal National Institutes of Health (NIH). A sparkling new research annex, built in 1970, doubled the size of the Forsyth Center, with funds from the NIH and "major donors," such as Warner Lambert, Colgate Palmolive, and Lever Brothers.[6]

Jack Hein's track record as a fund-raiser for the Forsyth Center and his support for fluoride's use in dentistry owed much to his membership in an informal old boy's club of scientists who had also once done research at the University of Rochester. The University had been a leading center for fluoride research in the 1950s and 1960s, with many of its graduate students taking leading roles in dental schools and research centers around the United States.

In 1983, a year after Phyllis Mullenix arrived at Forsyth, director Hein introduced her to an elderly gentleman who had been Hein's professor and scientist mentor some thirty years earlier at the University of Rochester. The old man was a researcher with a distinguished national reputation—the first president of the Society of Toxicology, Mullenix learned, and the author of scores of academic papers and books. His name was Harold Carpenter Hodge, and his impeccable manners and formal dress left an indelible impression on Mullenix.

"I was impressed with Harold," she said. "He was very gentlemanly. He would never say an inappropriate word, and he always wore a white lab coat."

Hodge had recently retired from the University of San Francisco. Jack Hein had brought him to Forsyth for the prestige he would bring to Mullenix's new toxicology department, he said, and out of admiration for his former professor, who was then in his mid-seventies. “I thought it would be fun,” Hein added.

Mullenix grew fond of Hodge. He seemed almost grandfatherly, ambling into her laboratory, chatting as her young children frolicked alongside. Hodge was especially fascinated by the new computer system for testing chemical toxicity. He would fire endless questions at Mullenix and her colleague, Bill Kernan from Iowa State University, Mullenix remembered. “He would quietly come up to my lab. And Harold would ask ‘Why are you doing this?’ and ‘What are you doing?’ and Bill [Kernan] would take great pains to explain every little scientific detail, showing him the rat pictures.”

By the early 1980s Jack Hein’s vision for the Forsyth Center included more than just dentistry. The canny fund-raiser believed that the new Mullenix technology could become another big money spinner for Forsyth—a winning weapon in the high-stakes field of toxic tort litigation, in which workers and communities allege they have been poisoned by chemicals. “It was an exciting new way of studying neurotoxicity,” said Jack Hein, who would eventually assign Mullenix to spacious new offices and laboratories on the fourth floor of the Forsyth research annex.

Neurotoxicology was still a young science. If someone claimed to have been hurt by a chemical in the workplace or had been exposed in a pollution incident, finding the scientific truth was extraordinarily difficult. Big courtroom awards against industry often hinged on the subjective opinion of a paid expert witness and the unpredictable emotions of a jury, said Mullenix. "Industries did not like that. They felt that the answers were biased, and so the thought of taking investigator bias out of the system was very exciting to them. They thought this would help [industry] in court," she added.

The Computer Pattern Recognition System quickly attracted attention from other scientists, industry, and the media. The *Wall Street Journal* called the Mullenix technology "precise" and "objective." [7] Some of America's biggest corporations opened their wallets. The medical director of the American Petroleum Institute personally gave $70,000 to Mullenix. Monsanto gave $25,000. Amoco and Mobil chipped in thousands more, while Digital Equipment Corporation donated most of the powerful computer equipment.

"Several oil and chemical companies such as Monsanto Co. are supporting research on the system," the *Wall Street Journal* reported. "Questions are being raised more frequently about whether there are behavioral effects attributable to chemicals," a Monsanto toxicologist, George Levinskas, told the newspaper. The Forsyth system "has potential to give a better idea of the effects our chemicals might have," he added.[8]

In a letter of recommendation, Myron A. Mehlman, the former head of toxicology for the Mobil Oil Corporation, who was then working for the federal Agency for Toxic Substances and Disease Registry (ATSDR), called the Mullenix technology "a milestone for testing low levels of exposure of chemicals for neurotoxicity for the 21st Century. . . . The benefits of Professor Mullenix' discovery to Forsyth are enormous and immeasurable."[9]

Industry trusted Phyllis Mullenix. Since the 1970s the toxicologist had earned large fees consulting on pollution issues and the legal requirements of the Clean Air Act. Hired by the American Petroleum Institute, for example, she'd acted as scientific coordinator for that lobby group, advising it on proposed and restrictive new EPA standards for ozone. "Whenever it got technical they would dance me out," she said. "Every time EPA came out with another criteria document I would look for the errors."

Mullenix is not apologetic for waltzing with industry. Anybody could take her to the ball, she said, explaining, "I did not look at myself as a public health individual. I was amazed that the EPA did such shoddy work writing a criteria document. I thought that at the very least those documents should be factual."

At Harvard, Mullenix had been criticized by some academics for her industry connections, a charge she calls "ridiculous." Said Mullenix, "No one group, be it government, academia or industry, can be right one hundred percent of the time. I don't see science as aligning yourself with one group. Industry can be right in one respect and they can be very wrong in another."

And Mullenix had other consulting work—for companies such as Exxon, Mobil, 3M, and Boise Cascade. Companies including DuPont, Procter and Gamble, NutraSweet, Chevron, Colgate-Palmolive, and Eastman Kodak all wrote checks supporting a 1987 conference she held titled "Screening Programs for Behavioral Toxicity."

Like many revolutionary ideas, the concept behind the Mullenix technology for studying central-nervous-system problems was simple. The spark of inspiration had come from Dr. Mullenix's graduate advisor at the University of Kansas Medical Center, Dr. Stata Norton. A slender and soft-spoken woman, Dr. Norton was one of the first prominent female toxicologists in the United States. She had won national recognition by demonstrating that there were "threshold" levels for the toxic effects of alcohol and low-level radiation on the fetus. Now retired to her summer cottage, surrounded by lush Kansas farmland, Dr. Norton's face opened in a smile as she remembered her former student. Normally, she said, graduate students rotated through the various laboratories at the Medical Center. But there was something different about Phyllis Mullenix.

"Phyllis came into my lab to do a short study—and she never left," Norton recalled, laughing.

Mullenix had a special willingness to grapple with complex new information, Norton said. When Norton was studying the effects of radiation on rats, Mullenix wanted to learn how the radiation had physically altered the rats' brains. She had never done that work before, Norton recalled, but her student stayed late at the lab, poring over medical journals, dissecting the rat's brains, and looking for tiny changes caused by the radiation. "I don't think she thought it was difficult," said Norton. "She was happy to jump on the project and get with it."

There was something else. Norton noticed her student had a fearless quality and a willingness to challenge conventional wisdom. The professor found it refreshing. "It takes a certain personality to stand up and do something different. Science is full of that, all the way from Galileo," Norton said. "That doesn't mean you are right or you are wrong, but I can appreciate that in Phyllis because I am like that."

In the mid-1970s Stata Norton was a pioneer in the new field of behavioral toxicology, inventing new ways for measuring the ways chemicals affected behavior. At first Norton studied mice that had been trained or "conditioned" to behave in certain ways by receiving food rewards. Some scientists believed that by studying disruptions in this "conditioned" behavior, they could most accurately measure the toxic effects of different chemicals.

Norton was not so sure. One day, working with mice that had been trained to press a lever for food at precisely timed intervals, she suddenly wondered how the animals knew when to press the lever. “I looked in the box,” she said. Inside she saw that each mouse seemed to measure the time between feeding by employing a “sequence” or pattern of simple activities such as sitting, scratching, or sniffing. “There was a rhythm,” she explained. “They timed it by doing things.”

Norton began her own experiments. She wondered if, by studying changes in this rhythm of “patterned” behavior during the time between feeding—as opposed to studying disruptions in the conditioned behavior exhibited for food rewards—she could get a more sensitive measurement of the toxicity of chemicals. Norton and Mullenix took thousands of photographs of rats that had been given a chemical poison and compared them with similar photographs of healthy “control” rats. They were able to detect changes in the sequences of the rats’ behavior, even at very low levels of chemical poisoning. “We were all very excited,” said Norton.

The spirit of independence and free inquiry in Stata Norton’s laboratory inspired Phyllis Mullenix. It was the kind of environment she had grown up in. Her mother, Olive Mullenix, was a Missouri schoolteacher who’d ridden sixteen miles on horseback to her one-room schoolhouse each day and made her "own" money selling fireworks from a roadside stand. Her father, "Shockey" Mullenix (he had a shock of white hair), had left the farm with a dream to become a doctor. He settled for the workaholic life of a gas-station entrepreneur and trader in the small town of Kirksville, Missouri and the hope that his three children would realize his dreams. The son became a nuclear physicist for the Department of Energy; another daughter was a corporate Washington lawyer; and the youngest, Phyllis, the Harvard toxicologist.

In the late 1970s the Environmental Protection Agency grew interested in the Kansas research. The federal agency wanted a new way of measuring the human effects of low-level chemical contamination. The head of the EPA's neurotoxicology division, Lawrence Reiter, visited Stata Norton's laboratory. Phyllis Mullenix told him that the key to the success of the new technique was to speed up the time-consuming process of analyzing each frame of film. Mullenix thought that computers could do the job faster. The EPA agreed, and Mullenix became a consultant on a $4 million government grant awarded to Iowa State computer experts Bill Kernan and Dave Hopper. Kernan had worked previously for the

Defense Department, writing some of its most elegant and sophisticated software.

"I was to train the physicist," said Mullenix. "The physicist would train the computer."

Developing the Computer Pattern Recognition System, as Mullenix's technology became known, took almost thirty years. Dr. Norton had begun studying her rats in the 1960s. When she passed the baton to Phyllis Mullenix in the 1970s, computers were barely powerful enough to handle the vast data-processing requirements for detecting subtle behavior changes and measuring chemical poisoning.

In Boston in the mid-1980s Mullenix grew incredibly busy. She now had two young daughters. She was consulting for industry. Her husband, Rick, was completing training as an air-traffic controller. And her father was seriously ill with emphysema 1500 miles away in Kirksville, Missouri.

Her Forsyth laboratory buzzed with activity. The new computers were hooked up by telephone to big data-processing units at Iowa State. By late 1987 the Computer Pattern Recognition System was almost ready. Forsyth printed brochures, touting a system that promised to "prevent needless exposure of the general public to the dangers of neurotoxicity, and industry to exaggerated litigation claims." Mullenix soon became a national pitchwoman for Forsyth, proclaiming a new day for corporations that feared lawsuits from workers and communities for chemical exposures. "I was hopped all over the country giving seminars on how this computerization was going to help the industrial situation," she said.

Director Jack Hein was anxious to illustrate the sensitivity of the new machine. He suggested that Mullenix start with fluoride, giving small doses to rats and testing them in the equipment. The longtime fluoride supporter wanted to test fluoride first, he said, in order to bolster the chemical's public image. "I was really interested in proving there were no negative effects," Hein said. "It seemed like a good way of negating the antifluoridationist arguments."

Mullenix shrugged. She didn't much care about fluoride. Secretly she thought that fluoride was a waste of her time and that Jack Hein was overreacting. "At Harvard the rule is publish or perish. And I didn't think that I would come up with anything that would be worth publishing," she said. "I'm used to studying hard-core neurotoxic substances, drugs like anticonvulsants, radiation, where it can totally distort the brain. I never heard anything about fluoride, except TV commercials that it is good for your teeth."

Hein introduced her to another young dental researcher, Pamela DenBesten, who had recently arrived at Forsyth. DenBesten was studying the white and yellow blotches, or mottling, on tooth enamel caused by fluoride known as dental fluorosis. Although Mullenix was lukewarm to the idea of using fluoride to test for central-nervous-system effects, DenBesten was more curious. She had noticed that when she gave fluoride to rats for her tooth-enamel studies, they did not behave "normally." While it was usually easy to pick up laboratory rats, the animals that had been fed fluoride would "practically jump out of the cage," DenBesten said.

The two women worked well together. Phyllis would often bring her two young daughters to work, and the Mullenix laboratory on the fourth floor became a sanctuary from the predominantly male atmosphere at Forsyth. DenBesten knew that Phyllis Mullenix had few friends at Forsyth. Many of the other researchers were hostile to the plainspoken toxicologist. DenBesten describes it as "genderdiscrimination type stuff."[10]

Another Forsyth scientist, Dr. Karen Snapp, quickly made friends with Phyllis Mullenix. “I was always told that Phyllis was the batty woman up in the tower on the fourth floor,” said Snapp. “I ran into her at lunch one day in the cafeteria. We started chatting, then we went out and had a coke together.” Snapp found Mullenix refreshing, both for the quality of her science and her plainspoken manner. “She didn’t bow down to the powers that be at Forsyth. A lot of people put up fronts and are very pious, and Phyllis was not that way at all—that is what I liked about her. She was very honest, very straightforward, you knew exactly where you stood,” Snapp explained.

Snapp was also impressed with the rigor Mullenix brought to her scientific experiments. “She was very, very thorough. She at times had no idea what the outcome of an experiment was going to be. If she did an experiment and didn’t get the result she thought she should get, she’d repeat it to make sure it was right, and [if the unexpected data held up] it’s like, well—we change the hypothesis.”

If Phyllis Mullenix was at first nonchalant about testing fluoride for central-nervous-system effects, that was not the attitude of perhaps the “oldest boy” at the Forsyth Center. She found that Dr. Harold

Hodge, the affable old man in the freshly pressed lab coat, took what then seemed an almost obsessive interest in her fluoride work, firing endless questions about her methodology.

"He wanted to push me to do certain fluoride studies, and do this and do that, and how can I help?" said Mullenix.

2

Fireworks at Forsyth

The two white-coated scientists stared at each other, startled. High above Boston, surrounded by computer terminals and data printouts and the bright lights of a modern toxicology laboratory, Phyllis Mullenix and Pamela DenBesten fell suddenly silent. Only the white rats in their cages scuttered and sniffed. The information slowly sank in. The scientists had repeated their experiment and, once again, the results were the same. They laughed, nervously.

"Oh shit," Dr. Phyllis Mullenix finally blurted out. "We are going to piss off every dentist in the country."

BY 1989 THE Mullenix team was getting its first results from the fluoride experiments. They had been gathering data for two years, giving the rats moderate amounts of fluoride, monitoring them in their cages, and then analyzing the data in the

RAPID computer system, as her new technology was known. But something was wrong. The results seemed strange.

"Data was coming back that made me shake my head," said Mullenix. "It wasn't at all what we expected." Mullenix had expected that giving fluoride in drinking water would show no effect on the rats' behavior and central nervous system. Mullenix wondered if the problem was a bug in the new machinery. The team launched an exhaustive series of control experiments, which showed that the RAPID computers were working fine. All the results were "amazingly consistent," said Mullenix.

Fluoride added to their drinking water produced a variety of effects in the Forsyth rats. Pregnant rats gave birth to "hyperactive" babies. When the scientists gave fluoride to the baby rats following their birth, the animals had "cognitive deficits," and exhibited retarded behavior. There were sex differences, too. Males appeared more sensitive to fluoride in the womb; females were more affected when exposed as weanlings or young adults.

The two women told Jack Hein and Harold Hodge about the results. The men ordered them to repeat the experiments, this time on different rats.

The team performed still more tests. Mullenix remembers that Harold Hodge kept asking her about the results, even though he was by now very ill. He had gone to his home in Maine but kept in contact by telephone. He asked every day.

By 1990 the data were crystal clear. The women had tested more than five hundred rats. "I finally said we have got enough animals here for statistical significance," said Mullenix. "There is a problem," she added.

The two women talked endlessly about what they had found. Mullenix was a newcomer to fluoride research, but Pamela DenBesten had spent her career studying the chemical. She suspected that they had made an explosive discovery and that dentists in particular would find the information important. "My initial gut reaction was that this is really big," said DenBesten. Although the Forsyth rats had been given fluoride at a higher concentration than people normally drink in their water—an equivalent of 5 parts per million as opposed to 1 part per million—DenBesten also knew that many Americans are routinely exposed to higher levels of fluoride every day. For example, people who drink large amounts of water, such as athletes or laborers in the hot sun; people who consume certain foods or juices with high fluoride levels; children who use fluoride supplements from their dentists; some factory workers, as the result of workplace exposure; or certain sick people, all can end up consuming higher cumulative levels of fluoride. Those levels of consumption begin to approach—or can even surpass, for some groups—the same fluoride levels seen in the Forsyth rats.

"If you have someone who has a medical condition, where they have diabetes insipidus where you drink lots of water, or kidney disease—anything that would alter how you process fluoride—then you could climb up to those levels," said DenBesten. She thought that the Forsyth research results would quickly be followed up by a whole series of additional experiments examining, for example, whether fluoride at even lower levels, 1 part per million, produced central-nervous-system effects. "I assumed it would take off on its own, that a lot of people would be very concerned," she added.

Jack Hein was excited as well, remembers Mullenix. (Harold Hodge had died before she could get the final results to him.)[1] "Hein said, 'I want you to go to Washington,'" Mullenix said. "'Go to the National Institute of Dental Research and give them a seminar. Tell them what you are finding.'"

Jack Hein knew that if more research on the toxicity of low-dose fluoride was to be done, the government's National Institutes of Health and the U. S. Public Health Service needed to be involved.

THE CAMPUS-STYLE GROUNDS of the federal National Institutes of Health (NIH), just north of Washington DC, have the leafy spaciousness of an Ivy League college. White-coated scientists and government bureaucrats in suits and ties stroll the tree-lined walkways that connect laboratories with office buildings. This is the headquarters of the U.S. government's efforts to coordinate health research around the country, with an annual budget of $23.4 billion forked out by US taxpayers.[2] The campus is the home of the different NIH divisions, such as the National Cancer Institute and the National Institute of Dental Research (NIDR), as it was then known. (Today it is known as the National Institute of Dental and Craniofacial Research.)

On October 10, 1990, Phyllis Mullenix and Jack Hein arrived at the NIH campus to tell senior government scientists and policy makers about her fluoride research. As director of the nation's leading private dental-research institute, Jack Hein was well-known and respected at NIH. He had helped to arrange the Mullenix lecture. Mullenix was no stranger to public-health officials either. One of the Institutes' biggest divisions, the National Cancer Institute, had awarded her a grant that same year totaling over $600,000. The money was for a study to investigate the neurotoxic effects of some of the drugs and therapies used in treating childhood leukemia. Many of those drugs and radiation therapies can slow the leukemia but are so powerful that they often produce central-nervous-system effects and can retard childhood intelligence. The government wanted Mullenix to use her new RAPID computer technology at Forsyth to measure the neurotoxicity of these drugs.

To present her fluoride data, Mullenix and Hein had flown from Boston, arriving a little early. Hein met up with some old friends from NIDR, while Mullenix strolled into the main hospital building on the Bethesda campus, killing time before her seminar. In the hallway, the scientist started to giggle. On the wall was a colorful posterboard display, recently mounted by NIH officials, titled "The Miracle of Fluoride."

"I thought how odd," remembered Mullenix. "It's 1990 and they are talking about the miracle of fluoride, and now I'm going to tell them that their fluoride is causing a neurotoxicity that is worse than that induced by some cases of amphetamines or radiation. I'm here to tell them that fluoride is neurotoxic."

She read on. Ironically, her trip to Washington fell on the historic fortieth anniversary of the Public Health Service's endorsement of community water fluoridation. Mullenix knew little about fluoride's history. The chemical had long been the great white hope of the NIDR, once promising to vanquish blackened teeth in much the same way that antibiotics had been a magic bullet for doctors in the second half of the twentieth century, beating back disease and infection.

Terrible teeth had stalked the developed world since the industrial revolution, when the whole-grain and fiber diet of an earlier agrarian era was often replaced by a poorer urban fare, including increased quantities of refined carbohydrates and sugars.[3] Cavities are produced when bacteria in the mouth ferment such sugars and carbohydrates, attacking tooth enamel, with the resulting acid penetrating into the tooth's core. Hope of a simple fix for bad teeth arrived in the 1930s, when a Public Health Service dental researcher named Dr. H. Trendley

Dean reported finding fewer dental cavities in some parts of the United States, where there is natural fluoride in the water supply. Dean's studies became the scientific underpinning for artificial water fluoridation, which was begun in the 1940s and 1950s. Dean also became the first head of the NIDR. By the 1960s and 1970s, with rates of tooth decay in free fall across the United States, dental officials pointed a proud finger at the fluoride added to water and toothpaste. NIDR officials revered H. Trendley Dean as "the father of fluoridation."

"It was a major discovery by the Institute," said Jack Hein.

But opposition to fluoridation had been intense from the start. The postwar decline in rates of dental decay in developed nations had also occurred in communities where fluoride was *not* added to drinking water and had begun in some cases before the arrival of fluoride toothpaste.[4] Widespread use of antibiotics, better nutrition, improved oral hygiene, and increased access to dental care were also cited as reasons. And while medical and scientific resistance to fluoridation had been fierce and well-argued—the grassroots popular opposition was in many ways a precursor of today's environmental movement—Mullenix found the NIH's posterboard account of antifluoridation history to be oddly scornful. "They made a joke about antifluoridationists all being 'little old ladies in tennis shoes,'" she said. "That stuck in my mind."

Since Dean's day laboratory studies have forced a revolution in official thinking about how fluoride works.[5] While early researchers speculated that swallowed fluoride was incorporated "systemically" into tooth enamel even before the tooth erupted in a child's mouth—making it more resistant to decay—scientists now believe that fluoride acts almost exclusively from outside the tooth, or "topically" (such a "topical" effect has always been the explanation for how fluoride toothpaste functions, too). This new research says that fluoride defends teeth by slowing the harmful "demineralization" of calcium and phosphate from tooth enamel, which can leave teeth vulnerable to cavities. Fluoride also helps to "remineralize" enamel by laying down fresh crystal layers of calcium and a durable fluoride compound known as fluorapatite. And there is a third "killer" effect, in which the acid produced from fermenting food combines with fluoride, forming hydrogen fluoride (HF). This powerful chemical can then penetrate cell membranes, interfering with enzyme activity, and rendering bad bacteria impotent.[6]

"I still believe that fluoride works," says the Canadian dental researcher turned critic of water fluoridation, Dr. Hardy Limeback. "It works topically."

But these new ideas have not quenched the old debate. Dental officials now argue that water fluoridation produces a lifelong benefit not just for children; by bathing all teeth in water, officials argue, fluoride is continually repairing and protecting tooth enamel in teeth of all ages. Critics worry, however, that if hydrogen fluoride can inhibit bacteria enzymes in the mouth, then swallowing fluoride may unintentionally deliver similar "killer" blows to necessary bodily enzymes, thus also inhibiting the ones we need.[7]

Phyllis Mullenix, reading the NIH fluoride posters and preparing to give her speech on that fall day in 1990, knew almost nothing of the history of controversy surrounding fluoride. She was about to walk into the lion's den. She was stunned when she entered the lecture hall at the National Institutes of Health. It was packed. There were officials from the Food and Drug Administration. She spotted the head of the National Institute of Dental Research, Dr. Harald Löe, and she noticed men in uniform from the Public Health Service.

The lights dimmed. Mullenix told them about the new RAPID computer technology at Forsyth. At first the audience seemed excited. Then she outlined her fluoride experiment. She explained that the central-nervous-system effects seen in the rats resembled the injuries seen when rats were given powerful antileukemia drugs and radiation therapies. The pattern of central-nervous-system effects on the rats from fluoride "matched perfectly," she said.

The room fell suddenly quiet. She attempted a joke. "I said, 'I may be a little old lady, but I'm not wearing tennis shoes,'" she remembers. "Nobody was laughing. In fact, they were really kind of nasty."

The big guns from the NIH opened up. Hands shot into the air. "They started firing question after question, attacking me with respect to the methodology," remembered Mullenix. She answered their questions patiently, and finally, when there were no more hands in the air, she and Jack Hein climbed into a cab and headed for the airport.

Jack Hein is reluctant to discuss these long-ago events. It was a messy ending to his career. He retired from Forsyth the following year, in 1991. He agrees that the Mullenix fluoride results were unpopular but adds that data showing fluoride damage to the central nervous system should have been "vigorously" followed up. "That perspective had never been looked at before," he remarks. "It turned out there was something there." Hein believes that getting the NIDR and the government to change their position on fluoride, however, is a difficult task. Many senior public-health officials have devoted their professional careers to promoting fluoride. "NIDR really fought hard showing that fluoride was effective," Hein says. "It was a major discovery by the Institute. "They did everything they could to promote it."[8]

Hein made a final effort to sound a warning on fluoride. He told Mullenix that he was going to call a meeting of industry officials whose products contained fluoride. Like Mullenix, Hein had spent a career cultivating ties with various large-scale industries. He sent her a note listing the "people who are coming for a private 'Fluoride Toxicity'" conference that would be held in his Forsyth office. "He said, 'NIDR were being stupid, the industries will respond better,'" Mullenix recalls.

Several months after the Washington seminar, Phyllis Mullenix sat at the table in Jack Hein's office with representatives from three of the world's most powerful drug companies: Unilever, Colgate-Palmolive, and SmithKline Beecham. Anthony Volpe, Colgate-Palmolive's Worldwide Director of Clinical Dental Research, was there, and so was Sal Mazzanobile, Director of Oral Health Research for Beecham. The senior scientist Joe Kanapka was sent by the big transnational company Unilever.

Mullenix outlined her fluoride findings. The men took notes. Suddenly Joe Kanapka of Unilever leaned back in his chair with an exasperated look. "He said, 'Do you realize what you are saying to us, that our fluoride products are lowering the IQ of children?'" remembers Mullenix. "And I said, 'Well yes, that is what I am saying to you.'" As they left, the men "slapped me on the back," Mullenix said, telling her, "We will be in touch, we need to pursue this."

The next day a note from Jack Hein's office arrived with the telephone numbers of the industry men, so that she could follow up. "I did call them," says Mullenix. "And I called. And the weeks went by and the months went by." Eventually Joe Kanapka from Unilever called back, she remembers. "He says, 'I gave it to my superiors and they haven't gotten back to me.'"

Contacted recently, Joe Kanapka said that he had visited Forsyth "many times" but had no memory of the fluoride conference. When asked if he had once worried that his products might be hurting children's intelligence, he replied, "Oh God, I don't remember anything like that, I'm sorry." He explained that open-heart surgery had temporarily impaired his memory. "I don't remember who Mullenix is," he added.

Beecham's Sal Mazzanobile remembers the meeting. The fluoride data presented that day were "preliminary," he recalled. Mullenix never called him again, he claims, and he therefore presumed her data were inaccurate. "I can't see why, if somebody had data like that, they would not follow up with another study in a larger animal model, maybe then go into humans," he said. "It could be a major health problem."

Did the director of consumer brands at Beecham—makers of several fluoride products—call Mullenix himself or find out if her data were ever published? "I wasn't the person responsible to follow up, if there was a follow-up," Mazzanobile answered. He did not remember who at Beecham, if anybody, might have had responsibility for keeping apprised of the Mullenix research.

Procter and Gamble followed up on Mullenix's warning. They flew her out to their Miami Valley laboratories in Cincinnati. Mullenix flew home with a contract and some seed money to begin a study to look at the effects of fluoride on children's intelligence. Shortly afterward, however, "they pulled out and I never heard from them again," recalls Mullenix.

In 1995 Mullenix and her team published their data in the scientific journal *Neurotoxicology and Teratology*. Their paper explained that, while a great deal of research had already been done on fluoride, almost none had looked at fluoride's effects on the brain. And while earlier research had suggested that fluoride did not cross the crucial blood brain barrier, thus protecting the central nervous system, Mullenix's findings now revealed that "such impermeability does not apply to chronic exposure situations."[9]

When the baby rats drank water with added fluoride, the scientists had measured increased fluoride levels in the brain. And more fluoride in the brain was associated with “significant behavioral changes” in the young rats, which resembled “cognitive deficits,” the scientists reported. The paper also suggested that when the fluoride was given to pregnant rats, it reached the brain of the fetus, thus producing an effect resembling “hyperactivity” in the male newborns.

The Mullenix research eventually caught the attention of another team of Boston scientists studying central-nervous-system problems. They produced a report in 2000 reviewing whether toxic chemicals had a role in producing what they described as “an epidemic of developmental, learning and behavioral disabilities” in children. Their report considered the role of fluoride, and focused on the Mullenix research in particular. “In Harm’s Way—Toxic Threats to Child Development” by the Greater Boston chapter of Physicians for Social Responsibility described how 12 million children (17 percent) in the United States “suffer from one or more learning, developmental, or behavioral disabilities.” Attention deficit and hyperactivity disorder (ADHD) affects 3 to 6 percent of all school-children, although recent evidence suggests the prevalence may be much higher, the scientists noted. Not enough is known about fluoride to link it directly to

ADHD or other health effects, the report pointed out. Nevertheless, the existing research on fluoride and its central-nervous-system effects were "provocative and of significant public health concern," the team concluded.

The Mullenix research surprised one of the authors of the report, Dr. Ted Schettler. He had previously known almost nothing about fluoride. "It hadn't been on my radar screen," he said. Most startling was how few studies had been done on fluoride's central-nervous-system effects. Schettler turned up just two other reports, both from China, suggesting that fluoride in water supplies had reduced IQ in some villages."That just strikes me as unbelievable quite frankly," he said. "How this has come to pass is extraordinary. That for forty years we have been putting fluoride into the nation's water supplies—and how little we know about [what] its neurological developmental impacts are. . . . We damn well ought to know more about it than we do."

Does Mullenix's work have any relevance to children? Schettler does not know. Comparing animal studies to humans is an uncertain science, he explained. Nor was Schettler familiar with Mullenix's computer testing system. But the toxic characteristics and behavior of other chemicals and metals, such as lead and mercury, concern him. For those pollutants, at least, human sensitivity is much greater than in animal experiments; among humans, it is greater in children than in adults. The impact of other toxic chemicals on the developing brain is often serious and irreversible.

So is the Mullenix work worth anything? “I don’t know the answer to that,” Schettler said. “But what I do draw from it is that it is quite plausible from her work and others that fluoride interferes with normal brain development, and that we better go out to get the answers to this in human populations.”

The burden of testing for neurological effects falls on the Public Health Service, which has promoted water fluoridation’s role in dental health for half a century. “Whenever anybody or any organization attempts a public health intervention, there is an obligation to monitor emerging science on the issue—and also continue to monitor impacts in the communities where the intervention is instituted. So that when new data comes along that says, ‘Whoa, this is interesting, here is a health effect that we hadn’t thought about,’ we better have a look at this to make sure our decision is still a good one,” Schettler said.

Phyllis Mullenix says that she carried the ball just about as far as she could. Following the seminar at NIH, Harald Löe, the director of the National Institute of Dental Research, had written to Forsyth's director Jack Hein on October 23, 1990, thanking him and Mullenix for their visit and confirming "the potential significance of work in this area." He asked Mullenix to submit additional requests for funding. "NIDR would be pleased to support development of such an innovative methodology which could have broad significance for protecting health," Löe wrote.[10]

"I was very excited about that," said Mullenix. "I took their suggestions in the letter. [However] every one of them ended up in a dead end."[11] Mullenix now believes that the 1990 letter was a cruel ruse—to cover up the fact that the NIH had no interest in learning about fluoride's potential central-nervous-system effects. "What they put in writing they had no intentions [of funding]. It took years to figure that out," she says.

Dr. Antonio Noronha, an NIH scientific-review adviser familiar with Dr. Mullenix's grant request, says a scientific peer-review group rejected her proposal. He terms her claim of institutional bias against fluoride central-nervous-system research "farfetched." He adds, "We strive very hard at NIH to make sure politics does not enter the picture."[12]

But fourteen years after Mullenix's Washington seminar the NIH still has not funded any examination of fluoride's central-nervous-system effects and, according to one senior official, does not currently regard fluoride and central-nervous-system effects as a research priority. "No, it certainly isn't," said Annette Kirshner, a neurotoxicology specialist with the National Institute of Environmental Health Studies (NIEHS). Dr. Kirshner confirmed that although "our mission is to look into the effects of toxins [and] adverse environmental exposures on human health," she could recall no grants being given to study the central-nervous-system effects of fluoride. "We'd had one or two grants in the past on sodium fluoride, but in my time they've not been 'neuro' grants, and I've been at this institute about thirteen and a half years." Does NIEHS have plans to conduct such research? "We do not and I doubt if the other Institutes intend to," said Dr. Kirshner by e-mail.

Nor do the government's dental experts plan on studying fluoride's central-nervous-system effects any time soon. In an e-mail sent to me on July 19, 2002, Dr. Robert H. Selwitz of the same agency wrote that he was "not aware of any follow-up studies" nor were the potential CNS effects of fluoride "a topic of primary focus" for government grant givers. Dr. Selwitz is the Senior Dental Epidemiologist and Director of the Residency Program in Dental Public Health, National Institute of Dental and Craniofacial Research, NIH. At first he appeared to suggest that the Mullenix study had little relevance for human beings, telling me that her rats were "fed fluoride at levels as high as 175 times the concentration found in fluoridated drinking water."

But his statement was subtly misleading. Rats and humans have very different metabolisms, and in laboratory experiments these differences must be compensated for. The critical measurement in studying effects on the central nervous system is not how much fluoride is given to the laboratory animals but how much of the chemical, after they drink it, subsequently appears in the animals' blood. The amount of fluoride in the blood of the Mullenix rats—a measurement known as the blood serum level—had been the equivalent of what would appear in the blood of a human drinking about 5 parts per million of fluoride in water. This, of course, is just five times the level the government suggests is "optimal" for fluoridated water—1 ppm. I asked Dr.

Selwitz, therefore, if it was fair to portray the Mullenix rats as having drunk "175 times" the amount of fluoride that citizens normally consume from fluoridated water.

Wasn't the "blood serum" measurement and comparison more relevant? Wasn't his statement, inadvertently at least, misleading?

Dr. Selwitz, who had just been ready to dispense medical arguments and implied reassurances as to why Mullenix's research was not relevant to human beings, now explained that he could not answer my question. "The questions you are asking in your recent e-mail message involve the field of fluoride physiology," wrote the senior dental epidemiologist at NIDCR. "This subject is not my area of expertise."

FAR FROM USHERING in new opportunities for scientific research, Mullenix's fluoride studies appear to have spelled the death knell for her once-promising academic career. When Jack Hein retired from Forsyth on June 30, 1991, the date marked the beginning of a very different work environment for Phyllis Mullenix. She gave a seminar at Forsyth on February 20, 1992, outlining what she had discovered and explaining that she hoped to publish a major paper about fluoride toxicity with Pamela DenBesten.

"That's when my troubles started," said Mullenix.

Pam DenBesten had been worried about the Boston seminar. Senior researchers at Forsyth, such as Paul DePaola, had published favorable research on fluoride since the 1960s. The seminar was "ugly," says Mullenix. DenBesten describes the scientists' response as "angry" and "sarcastic." "She was risking their reputation with NIH," DenBesten explains.

Karen Snapp remembers "hostile" questioning of Mullenix by the audience. "They looked upon Phyllis's research as a threat. The dental business in this country is focused on fluoride. They felt that funding would dry up. We are supposed to be saying that fluoride is good for you, whereas somebody is saying maybe it is not good for you. . . . In their own little minds, they were worried about that."

The following day Forsyth's associate director, Don Hay, approached Mullenix. "He said, 'You are going against what the dentists and everybody have been publishing for fifty years, that this is safe and effective. You must be wrong,'" Mullenix recalled. "He told me, 'You are jeopardizing the financial support of this entire institution. If you publish these studies, NIDR is not going to fund any more research at Forsyth.'"

Karen Snapp also remembers Don Hay as opposing publication of the paper. "He didn't believe the science. He didn't believe the results—and he did not think the paper should go out." Both Snapp and Mullenix were concerned that somehow Don Hay would prevent the paper from being published. "I think we were even laughing about it, saying 'I think in America we have something called freedom of the press, freedom of speech?'" Snapp recalls.

Don Hay calls allegations that he considered suppressing the Mullenix research "false." He told *Salon.com*: "My concern was that Dr. Mullenix, who had no published record in fluoride research, was reaching conclusions that seemed to differ from a large body of research reported over the last fifty years. We had no knowledge of the acceptance of her paper prior to the time she left [Forsyth]."[13]

Editor Donald E. Hutchings of *Neurotoxicology and Teratology*, where the Mullenix paper was published, says that there was no effort to censor or pressure him in any way. Her study was first "peer-reviewed" by other scientists, revised, and then accepted. "Was I called and told that 'If you publish this we are going to review your income taxes, [or] send you a picture of J. Edgar Hoover in a dress?' No," he said. Hutchings was a little bemused, however, to get such a critical paper on fluoride from a Forsyth researcher. He knew that Forsyth had long been a leading supporter of a role for fluoride in dentistry. "It almost strikes me like you are working in a distillery and you are doing work studying fetal alcohol syndrome. That is not work that they are going to be eager to be sponsoring. I didn't care—it wasn't my career. I thought it was really courageous of her to be doing that."

On May 18, 1994—just days after the paper had been accepted—Forsyth fired Mullenix. The termination letter merely stated that her contract would not be renewed. There was no mention of fluoride. A new regime was now installed at the Center. The toxicology department was closed, and a new Board of Overseers had been established, with the mission "to advise the Director in matters dealing with industrial relationships."[14]

Mullenix describes the final couple of months at Forsyth as the lowest ebb in her career. The big grant from the National Cancer Institute had dried up and her laboratory conditions were horrible, she said. "The roof leaked, they destroyed the equipment, they destroyed the animals. That was the lowest point, right before I physically moved out in July 1994. Nobody would even talk to me."

Her mother remembers Phyllis calling frequently that summer. "She was very upset about it," said Olive Mullenix. At first she wondered if her daughter had done something wrong. Phyllis explained that her fluoride research had been unpopular. "There was no use to get angry," said Olive Mullenix. "She was honest about what she found and they didn't like it."

Stata Norton got calls too from her former student. Norton was not surprised at the hostile response from Forsyth. She knew that clean data can attract dirty politics. "There are situations in which people don't want data challenged, they don't want arguments," said Norton.

The implications of Mullenix's work have been buried, according to her former colleague, the scientist Karen Snapp. "Is it fair to say that we don't know the answer to the central-nervous-system effects of the fluoride we currently ingest? I think that Phyllis got just the tip of the iceberg. There needs to be more work in that area," Snapp said.

Jack Hein wishes that he had approached things differently. He knew that the scientific landscape of the last fifty years was "littered with the bodies of a lot of people" who, like Phyllis Mullenix, "got tangled up in the fluoride controversy." His team should have tested other dental materials before tackling fluoride, said Hein. "It would have been better if we had done mercury and then fluoride," he said. "Less controversial."

It would have made no difference, believes Mullenix. Nor does she believe another scientist would have been treated differently. She had stellar academic credentials, powerful industry contacts, and hard scientific data about a common chemical. "That is the sad part of it," she said. "I thought I had the people back then. I thought you could reason one scientist to another. I don't know that there is anything I could have done differently, without just burying the information."

Mullenix no longer works as a research scientist. Since her fluoride discovery at Forsyth a decade ago, she has received no funding or research grants. "I liked studying rats," she said. "I probably would have continued working with the animals my entire life. Now," she added, "I don't think I will ever get to work in a laboratory again."

Jack Hein and Pamela DenBesten knew about fluoride's bizarre undertow, one that could pull and snatch at even the most established scientist, and they were able to swim free from the Forsyth shipwreck. But Mullenix was dragged down by a tide that no one warned her about. "I didn't understand the depth," she said. "And to me, in my training, you pay no attention to that. The data are the data and you report them and you publish and you go from there."

Mullenix is disappointed at the response of her fellow scientists. Jack Hein walked off into the sunset of retirement. Most of her former colleagues were reluctant to support her call for more research on fluoride, she said. Instead of saying "maybe scientifically we should take another look, everybody took cover, they all dove into the bushes and wouldn't have anything to do with me."

Olive Mullenix did not raise her daughter that way. "You can't just walk away from something like this," Phyllis Mullenix said. "I mean, they had to find out that thalidomide was wrong and change. Why should fluoride be any different?"

"A Spooky Feeling"

ONE HOT JULY evening in 1995 the phone rang. Dr. Phyllis Mullenix was in her office, upstairs in her Andover, Massachusetts, home. Scientific papers were strewn on the floor. She had been depressed. Her firing from Forsyth the previous summer had hit the family hard. Her daughters were applying to college ; she and her husband, Rick, were quarreling about money.

She lifted the receiver. A big bass voice boomed an apology from New York City for calling so late. Mullenix did not recognize the speaker. She settled back into her favorite white leather armchair. Joel Griffiths explained that he was a medical writer in Manhattan. He had a request. Would Mullenix look at some old documents he had discovered in a U.S. government archive? The papers were from the files of the Medical Section of the Manhattan Project, the once supersecret scientific organization that had built the world's first atomic bomb.

Mullenix rolled her eyes. It was late. Rick, now an air traffic controller, was trying to sleep in the next room. The atom bomb, Mullenix thought! What on earth did that have to do with fluoride?

Mullenix's own patience was growing thin. Since her research had become public, she had been bombarded with phone calls and letters from antifluoride activists. Some of the callers had been battling water fluoridation since the 1950s. Late-night radio talk shows were especially hungry to speak with the Harvard scientist who thought that fluoride was dangerous. They called her at three or four in the morning from across the country and overseas. Usually "there was no thank you note, and you never heard from them again," Mullenix said.

The New York reporter dropped a bombshell. Dr. Harold Hodge, Mullenix's ...