

DOUBT **IS** **THEIR** **PRODUCT**

**How Industry's Assault on Science
Threatens Your Health**

David Michaels



Table of Contents

[Title Page](#)

[Copyright Page](#)

[Dedication](#)

[Introduction](#)

[Chapter 1 - The Manufacture of Doubt](#)

[Chapter 2 - Workplace Cancer before OSHA](#)

[Chapter 3 - America Demands Protection](#)

[Chapter 4 - Why Our Children Are Smarter Than We Are](#)

[Chapter 5 - The Enronization of Science](#)

[Chapter 6 - Tricks of the Trade](#)

[Chapter 7 - Defending Secondhand Smoke](#)

[Chapter 8 - Still Waiting for the Body Count](#)

[Chapter 9 - Chrome-Plated Mischief](#)

[Chapter 10 - Popcorn Lung](#)

[Chapter 11 - Defending the Taxicab Standard](#)

[Chapter 12 - The Country Has a Drug Problem](#)

[Chapter 13 - Daubert](#)

[Chapter 14 - The Institutionalization of Uncertainty](#)

[Chapter 15 - The Bush Administration's Political Science](#)

[Chapter 16 - Making Peace with the Past](#)

[Chapter 17 - Four Ways to Make the Courts Count](#)

[1. No More Court-Sanctioned Secrecy](#)

[2. Allow Injured Workers to Sue Their Employers](#)

[3. Develop Better Compensation Systems](#)

[4. End "Preemption by Preamble": Bad Public Policy and Bad for Public Health](#)

[Chapter 18 - Sarbanes-Oxley for Science](#)

[1. Require Full Disclosure of Any and All Sponsor Involvement in Scientific Studies](#)

[2. Is This Stuff Safe? Manufacturers Must Test Chemicals before Exposing ...](#)

[3. No More Secret Science: Manufacturers Must Disclose What They Know about the ...](#)

[4. Put an End to Rigged Data Reanalysis](#)

[5. The Lessons of Enron: Hold Real People Accountable](#)

[6. Level the Playing Field: Require Equal Treatment for Public and Private Science](#)

[7. Protect the Independence of Federal Scientists and the Science Advisory Committees](#)

[8. Regulation by Shaming: Increase Public Disclosure of Hazards](#)

[9. Require Corporations to Make a Plan and Stick to It](#)

[10. Embrace ALARA \("As Low as Reasonably Achievable"\)](#)

[11. Take Down the Stovepipes: Integrate the Control of Environmental and ...](#)

[12. Make the States Public Health Protection "Laboratories."](#)

[Acknowledgements](#)

[Abbreviations and Acronyms](#)

[References](#)

[Index](#)

DOUBT

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For Gail,
Joel, and Lila

Introduction: “Sound Science” or “Sounds Like Science”?

Since 1986 every bottle of aspirin sold in the United States has included a label advising parents that consumption by children with viral illnesses greatly increases their risk of developing Reye syndrome, a serious illness that often involves sudden damage to the brain or liver. Before the mandatory warning was required by the Food and Drug Administration (FDA), the toll from the disease was substantial: In one year—1980—555 cases were reported, and many others quite likely occurred but went unreported because the syndrome is easily misdiagnosed. One in three diagnosed children died.¹

Today, less than a handful of Reye’s syndrome cases are reported each year—a public health triumph, surely, but a bittersweet one because an untold number of children died or were disabled while the aspirin manufacturers delayed the FDA’s regulation by arguing that the science establishing the aspirin link was incomplete, uncertain, and unclear. The industry raised seventeen specific “flaws” in the studies and insisted that more reliable ones were needed.² The medical community knew of the danger, thanks to an alert issued by the Centers for Disease Control (CDC), but parents were kept in the dark. Despite a federal advisory committee’s concurrence with the CDC’s conclusions about the link with aspirin, the industry even issued a public service announcement claiming “We do know that no medication has been proven to cause Reyes” (emphasis in the original).³ This campaign and the dilatory procedures of the White House’s Office of Management and Budget delayed a public education program for two years and mandatory labels for two more.⁴ Only litigation by Public Citizen’s Health Research Group forced the recalcitrant Reagan Administration to act. Thousands of lives have now been saved—but only after hundreds had been lost.

Of course, the aspirin manufacturers did not invent the strategy of preventing or postponing the regulation of hazardous products by questioning the science that reveals the hazards in the first place. I call this strategy “manufacturing uncertainty”; individual companies—and entire industries—have been practicing it for decades. Without a doubt, Big Tobacco has manufactured more uncertainty over a longer period and more effectively than any other industry. The title of this book comes from a phrase unwisely committed to paper by a cigarette executive: “Doubt is our product since it is the best means of competing with the ‘body of fact’ that exists in the minds of the general public. It is also the best means of establishing a controversy” (emphasis added).⁵

There you have it: the proverbial smoking gun. Big Tobacco, left now without a stitch of credibility or public esteem, has finally abandoned its strategy, but it showed the way. The practices it perfected are alive and well and ubiquitous today. We see this growing trend that disingenuously demands proof over precaution in the realm of public health. In field after field, year after year, conclusions that might support regulation are always disputed. Animal data are deemed not relevant, human data not representative, and exposure data not reliable. Whatever the story—global warming, sugar and obesity, secondhand smoke—scientists in what I call the “product defense industry” prepare for the release of unfavorable studies even before the studies are published. Public relations experts feed these for-hire scientists contrarian sound bites that play well with reporters, who are mired in the tradition of believing there must be two sides to every story. Maybe there are two sides—and maybe one has been bought and paid for.

* * *

As it happens, I have had the opportunity to witness what is going on at close range. In the Clinton administration, I served as Assistant Secretary for Environment, Safety, and Health in the Department

of Energy (DOE), the chief safety officer for the nation's nuclear weapons facilities. I ran the process through which we issued a strong new rule to prevent chronic beryllium disease, a debilitating and sometimes fatal lung disease prevalent among nuclear weapons workers. The industry's hired gun acknowledged that the current exposure standard for beryllium is not protective for employees. Nevertheless, they claimed, it should not be lowered by any amount until we know with certainty what the exact final number should be.

As a worker, how would you like to be on the receiving end of this logic?

Christie Todd Whitman, the first head of the Environmental Protection Agency under the second President Bush, once said, "The absence of certainty is not an excuse to do nothing."⁶ But it is. Quite simply, the regulatory agencies in Washington, D.C., are intimidated and outgunned—and quiescent. While it is true that industry's uncertainty campaigns exert their influence regardless of the party in power in the nation's capital, I believe it is fair to say that, in the administration of President George W. Bush, corporate interests successfully infiltrated the federal government from top to bottom and shaped government science policies to their desires as never before. In October 2002 I was the first author of an editorial in *Science* that alerted the scientific community to the replacement of national experts in pediatric lead poisoning with lead industry consultants on the pertinent advisory committee.⁷ Other such attempts to stack advisory panels with individuals chosen for their commitment to a cause—rather than for their expertise—abound.

Industry has learned that debating the science is much easier and more effective than debating the policy. Take global warming, for example. The vast majority of climate scientists believe there is adequate evidence of global warming to justify immediate intervention to reduce the human contribution. They understand that waiting for absolute certainty is far riskier—and potentially far more expensive—than acting responsibly now to control the causes of climate change. Opponents of action, led by the fossil fuels industry, delayed this policy debate by challenging the science with a classic uncertainty campaign. I need cite only a cynical memo that Republican political consultant Frank Luntz delivered to his clients in early 2003. In "Winning the Global Warming Debate," Luntz wrote the following: "Voters believe that there is no consensus about global warming within the scientific community. Should the public come to believe that the scientific issues are settled, their views about global warming will change accordingly. Therefore, you need to continue to make the lack of scientific certainty a primary issue in the debate. . . .The scientific debate is closing [against us] but not yet closed. There is still a window of opportunity to challenge the science" (emphasis original).⁸

Sound familiar? In reality, there is a great deal of consensus among climate scientists about climate change, but Luntz understood that his clients can oppose (and delay) regulation without being branded as antienvironmental by simply manufacturing uncertainty.

* * *

Polluters and manufacturers of dangerous products tout "sound science," but what they are promoting just sounds like science but isn't. Only the truly naïve (if there are any of these folks left) will be surprised to learn that the sound science movement was the brainchild of Big Tobacco, as we shall see. While these corporations and trade associations are always on the side of sound science, everyone else in the public health field, according to this construct, favors "junk science." Posthumously, George Orwell has given us a word for such rhetoric. The vilification of any research that might threaten corporate interests as "junk science" and the sanctification of its own bought-and-paid-for research as "sound science" is indeed Orwellian—and nothing less than standard operating procedure today. But to give credit where credit is due, the sound science/junk science dichotomy has worked wonders as a public relations gimmick and has gained widespread acceptance in the current debate over the use

scientific evidence in public policy.⁹

We are at a crossroads, I believe. The scientific enterprise is at a crossroads. We need to understand what is going on in the name of “sound science” and what the consequences may be—and have already been—for public health. At its heart, this book documents the way in which product defense consultants have shaped and skewed the scientific literature, manufactured and magnified scientific uncertainty, and influenced policy decisions to the advantage of polluters and the manufacturers of dangerous products.

During my service at the Department of Energy, I was the chief architect of the historic initiative to compensate nuclear weapons workers who developed cancer and other diseases as a result of their work protecting America’s security. In addition, my research has contributed to the scientific literature on the health effects of exposure to asbestos and lead. I have been in the middle of the national debates over the regulation of beryllium, chromium, and diacetyl (the chemical in artificial butter flavor that is destroying workers’ lungs) and a leader in the science community’s response to the Bush administration’s attempts to stack scientific advisory committees and weaken federal regulatory agencies. All are the subject of this book. I have reluctantly omitted many other sagas, equally damning but in which I have had no involvement.

Throughout, I have included what may be an overabundance of references, but I make some strong claims and raise questions about the motives of some scientists and corporations along the way. I have been very careful to document these claims. I have posted many important unpublished documents, including the “smoking guns” that support these assertions, at www.DefendingScience.org, the website of the George Washington University School of Public Health and Health Services’ Project on Scientific Knowledge and Public Policy. These documents provide much additional and damning detail. I wish I could promise that the documents will be available on this website in perpetuity, but that is not the way the web or the world works. Regardless, you can rest assured that every story and every outrage presented in this book is absolutely true.

The Manufacture of Doubt

What did Big Tobacco know, and when did it know it? Lengthy books have been written to answer the question, but the short answer is “enough—and early.” For decades, cigarette manufacturers have known that their product is hazardous to our health, did not care, and took whatever measures were necessary to protect their profits. The industry’s scientists were not surprised in the least by the U.S. Surgeon General’s famous report in 1964,¹ which made crystal clear to the public the compelling conclusions of the scientific community. In fact, Big Tobacco knew the facts about smoking better than anyone. In their public statements, however, tobacco executives and their public relations coconspirators fudged, weaved, bobbed, and roped-a-dope almost to perfection.

In the 1970s, a decade after the famous report, researchers were hard at work trying to create the “safe” cigarette.² Safe from what? From the health hazards that were “not a statement of fact but merely an hypothesis” [emphasis in original], in the words of a Brown and Williamson Tobacco Corporation (B&W) public relations statement.³ In the eighties, the industry’s PR firms created the “sound science” movement as just one aspect of the all-out war declared on the regulation of secondhand smoke. In the nineties Big Tobacco beat down the FDA, the EPA, and OSHA. In 1996 Thomas Sandefur, the chairman and CEO of Brown and Williamson, sat before a committee of the U.S. House of Representatives and said with a straight face, “I do not believe that nicotine is addictive. . . .Nicotine is a very important constituent in the cigarette smoke for taste.”⁴ (For Jeffrey Wigand, a former B&W scientist, this testimony was the final straw. He later approached 60 Minutes with his inside knowledge of the industry deceit. Wigand’s story first became a magazine article in *Vanity Fair*⁵ and then a movie, *The Insider*, with Russell Crowe as Wigand and Al Pacino as Lowell Bergman, the 60 Minutes producer who saw his story about Wigand quashed by executives of Westinghouse, CBS’s corporate parent.)

For almost half a century, the tobacco companies hired consultants and scientists—swarms of them in times of greatest peril—initially to deny (sometimes under oath) that smokers were at greater risk of dying of lung cancer and heart disease, then to refute the evidence that secondhand smoke increases disease risk in nonsmokers. The industry and its scientists manufactured uncertainty by questioning every study, dissecting every method, and disputing every conclusion. What they could not question was the enormous, obvious casualty count—the thousands of smokers who die every day from disease directly related to their habit—but no matter. Despite the overwhelming scientific evidence, the tobacco industry was able to wage a campaign that successfully delayed regulation and victim compensation for decades—and it is still doing so.⁶⁻⁹

Tobacco wins the prize—hands down. No industry has employed the strategy of promoting doubt and uncertainty more effectively, for a longer period, and with more serious consequences. That lack of qualifier about consequences is what sets the tobacco story apart from, say, asbestos, or chromium, or beryllium. As a later Surgeon General’s report concluded, “Smoking is responsible for more than one of every six deaths in the United States. Smoking remains the single most important preventable cause of death in our society.”¹⁰

The number is still correct; the superlative is still the case.¹¹ Let’s see how Big Tobacco

accomplished this feat.

Practically from the moment people began smoking “certain dried leaves,” as Columbus referred one gift received from the indigenous residents of the New World (and unwittingly discarded), became apparent that long-term smokers could pay a price for whatever benefits they received in return. By the eighteenth century, doctors were writing about the oral tumors of the mouth and throat that seemed to afflict smokers, although many therapeutic effects were attributed to smoking at the time. The much lower life spans of that era, along with a lower incidence of smoking, somewhat concealed the mortality risk itself, but by the twentieth century, alert observers were beginning to wonder about that as well. In 1938 a study by a Johns Hopkins University scientist suggested a strongly negative correlation between smoking and lifespan.¹² The Associated Press wire service picked up this story, but it was generally ignored—or actively suppressed, in the view of George Seldes, foreign correspondent in the 1920s who turned muckraking press critic in the thirties. Seldes accused the press of caving in to the tobacco companies, all of whom bought reams of evocative advertising featuring happy smokers, similar to claims that producers of patent medicines made at the turn of the century. Incensed, Seldes started a newsletter in 1941, in which he published dozens of stories over the following decade linking tobacco to disease and premature death.¹³

In 1950 the scientific picture changed dramatically: Five studies in which smoking was powerfully implicated in the causation of lung cancer were published that year.¹⁴⁻¹⁸ Among these was Richard Doll and Austin Bradford Hill’s now classic paper “Smoking and Carcinoma of the Lung,” which appeared in the *British Medical Journal*. Doll and Hill reported that heavy smokers were fifty times as likely as nonsmokers to contract lung cancer.¹⁴ In 1952, researchers demonstrated that cigarette smoke “tar” painted on the backs of mice produced tumors, and the industry soon responded by introducing new, filtered cigarettes. By the following year, thirteen alarming case-control studies comparing smoking rates among smokers and non-smokers were circulating through the scientific community (and therefore the tobacco industry). Because association is not necessarily causation, however, there were many questions. What was the mechanism by which the tobacco smoke caused cancer? Were there other factors associated with both lung cancer and tobacco that might be responsible? Was there something in one’s constitution (which today we would explain as genetic) that increased both lung cancer risk and the propensity to smoke? If so, then smoking would not cause lung cancer; a third factor would cause them both. Smoking apparently increased risk not just of lung cancer but of a host of other diseases as well. To some researchers steeped in infectious disease epidemiology, it seemed implausible that many different diseases could be associated with a single cause.¹⁹

At the time, tobacco growers and cigarette manufacturers did not have even a trade association, primarily because they feared running afoul of antitrust legislation.²⁰ Wake up! cried John Hill of the public relations firm Hill and Knowlton (H&K). Get organized! In December 1953 he warned tobacco industry officials of big trouble looming just over the horizon. (Two years earlier, the chemical industry had hired Hill and Knowlton to handle the response to a well-publicized investigation by Representative James Delaney (D-NY) into carcinogens in the nation’s food supply, a probe prompted by public concern about additives that had proven carcinogenic in animals.^{21,22})

In 1953, with his success holding off Congressional action on food contamination, John Hill and his colleagues were well positioned to design a new campaign to convince the world that cigarette smoking is not dangerous. For starters, Hill warned the cigarette companies that they needed to embrace the principle that “public health is paramount to all else.” They should issue a statement to that effect. He shrewdly suggested that the word “research” be included in the name of a new

committee, and indeed the Tobacco Industry Research Committee (TIRC; later renamed the Council for Tobacco Research, or CTR) was soon up and running.^{8,20}

“Will the companies agree to sponsor new research which will provide definite answers to the charges?” Hill asked. On this question, a “clear-cut answer” was “deferred for the time being,” Hill wrote, because the industry was confident it could supply “comprehensive and authoritative scientific material which completely refutes the health charges.” Nevertheless, Hill had his doubts—and wise ones. Where was this research? He told the companies to get busy with a PR campaign that would be “pro-cigarette” and not merely defensive.²⁰ The only way they could fight science was *with* science. This prescient judgment was surely correct—but there was one catch. Could the industry come up with better science that independent observers would recognize as such?

Just six months later, the prospects did not look good. On June 21, 1954, E. Cuyler Hammond and Daniel Horn of the American Cancer Society (ACS) presented to the American Medical Association (AMA) the findings of the largest and most rigorous study to date on tobacco and health.²³ The conclusions from the study of the causes of death among 187,766 white men ages fifty to sixty-nine who had been previously interviewed by twenty-two thousand ACS volunteers around the country were so dramatic and so incendiary that the survey had actually been halted so the news could be published. Cigarette smokers had 52 percent more deaths (3,000 instead of 1,980). The heavier the smoking, the heavier the consequences. The Hammond-Horn report, published later that year in the *Journal of the American Medical Association (JAMA)*, made headlines around the country, and this should have been the end of the debate about whether smoking is dangerous.²⁴ Then and there, in 1954, every scientist and every executive should have said, “Yes, more research is needed, but until we find out that these results are incorrect, let’s assume that cigarettes are killers and treat them accordingly.”

At the AMA convention, Dr. Charles S. Cameron, medical and scientific director of the American Cancer Society, downplayed the call for action that was implicit within the study, which he had previously lauded. “Personally,” Cameron said, “I believe that a life of outward productiveness and inward serenity is more important than how long a life is, and therefore I could not try to convince anyone from what he believes contributes to his productivity and his happiness.”²³ With complicated statistics, he minimized the significance of the risks from smoking, while the public would have been better served if he had put the issue this way: A lifetime of smoking decreases a man’s lifespan by six to eight years on average. Perhaps that might have gotten the attention of Joe Two-Pack.

Or maybe not—because Big Tobacco was on the case now. The Tobacco Industry Research Committee responded cautiously to the Hammond-Horn report. Shortly before the AMA convention, a bombshell, Dr. Clarence Cook Little, former ACS director, was named scientific director for the industry’s committee.²⁵ (Little had been forced out of his ACS position a decade earlier by Mary Lasker, who led the effort to turn ACS into a powerful volunteer health organization. Lasker went on to become one of the leading figures in the philanthropic support of medical research; ironically, her fortune derived from the work of her husband, the advertising executive who transformed Lucky Strikes into the nation’s leading brand of cigarettes.⁹)

In responding to Hammond-Horn on behalf of the tobacco industry, Dr. Little called for “greatly extended, amplified and diversified basic research on the relation of various habits of the different types of human beings to their health and well-being throughout their life cycle.” The greatest need was for “further experimentation wisely conceived, patiently executed, and fearlessly and impartially interpreted in our search for truth.”²³

How about some honest research on cigarettes? That was not part of the agenda, however. Nor was any aspect of the industry’s uncertainty campaign ever guided by the glowing principles set forth

Dr. Little's statement. If they had been, imagine the positive impact of Dr. Cameron's blunt statement that the Hammond-Horn results "appear to be of first importance in consideration of the changing death rates of the past 25 years. If further validated, they point the way to the means of still further lengthening man's life span."²³

Indeed they did, but instead of industry research wisely conceived, patiently executed, and fearlessly and impartially interpreted in our search for truth—truth that might have saved hundreds of thousands of lives—the public and the scientific community got something else instead. Here I would like to cite some headlines from "Reports on Tobacco and Health Research," a rather short-lived journal published under the auspices of the Tobacco Institute. The primary audience was doctors and scientists, but also the news media; many of the articles reported information taken from published papers or unpublished presentations delivered at scientific meetings.²⁶ Remember that the headlines and the studies they describe date from 1961 to 1964, years after Dr. Little's clarion promise of cooperation in the search for truth:

- "Cancer Personality Pattern Is Reported to Begin in Childhood" (the report of a Scottish psychologist)²⁷
- "Lung Specialist Cites 28 Reasons for Doubting Cigarette-Cancer Link"²⁷
- "Test Results: Smoking Fails to Raise Cholesterol Levels"²⁷
- "Inhalation Tests Fail to Cause Lung Cancer; Virus Suggested"²⁸
- "Scientists Report Lung Cancer Rise Linked to Decline in TB"²⁹
- "Marital Data Show 'Fallacy' of Using Correlations to Find Disease Causes"³⁰
- "Psychological, Familial Factors May Have Roles in Lung Cancer"³¹
- "Measles Virus Proposed as Cause of Emphysema" (this from a New York internist)²⁷
- "Smokers, Non-Smokers Differ in Weight, Size" (this from a Harvard anthropologist)³²
- "March Birth, Lung Cancer Linked" (a Dutch study)³²

The list goes on and on:

- "Heart Rate Deaths Reported Levelling [sic]; Elderly Smokers' Health Studied"³²
- "Miners' Lung Cancers Triple Average"³²
- "Smoke 'Tars' Give Negative Results"³²
- "Do British Doctors Smoke More or Less Than Other Graduates?" (This study refuted the idea that doctors smoke less because of their "special knowledge" of the alleged health hazards.)³²
- "Rare Fungus Infection Mimics Lung Cancer" (Two Toronto physicians studied three cases.)³²
- "Follow-up Study Sheds New Light on Smoking and Infant Survival" (This study from University of California biostatistician showed that small babies of smoking mothers were much less likely to die than those born to nonsmokers.)³³
- "Lung Cancer Rare in Bald Men" (Two New Orleans physicians conducted this research.)³³
- "Massive German Study Points to Occupational Hazards in Lung Cancer"³³
- "Nicotine Effect Is Like Exercise"³³
- "Scientist Links Amount of Smoking with Degree of Extroversion/ Personality Types, Cancer Also Found Associated"³⁴
- "Reverse Smokers Are Free of Cancer" (The head of Harvard's Forsyth Dental Center conducted this study of Caribbean smokers who inhale from the lighted end.)³⁴

- “English Surgeon Links Urbanization to Lung Cancer”³⁴
- “In 4,012 Cancer Autopsies . . . Find 26% Metastasize to Lung”³⁴
- “Finds Occupational Tie in Lung, Gastric Cancer”³⁵
- “Nearly Half of 1,000 Lung Cancer Cases Found to Be Non-Smokers”³⁵

Some of these studies sound reasonably plausible, whereas some sound ludicrous, but all of them were motivated by the same principle: Find other causes for disease, find smokers who do not have disease, find new associations of whatever sort, find this, find that, find anything—but the truth. Always and always contest the methods that epidemiologists used. Argue that “expectation-led” interviewee bias results.^{36,37} And because everyone knows our memories are faulty, emphasize “recall bias.” Industry documents argued that this bias was the Achilles’ heel of epidemiology, and that “failure to consider how the peculiarities of memory affect the studies underlying the policy decisions may fatally flaw the policies themselves.” As Hill and Knowlton promised, the headlines “strongly call for the point—Controversy! Contradiction! Other Factors! Unknowns!”²⁶

The industry understood that the public is in no position to distinguish good science from bad. Create doubt, uncertainty, and confusion. Throw mud at the “antismoking” research under the assumption that some of it is bound to stick. And buy time, lots of time, in the bargain.

All that said, one means by which science moves toward the real truth is by challenging and disproving supposed truth and received wisdom. It is certainly legitimate for scientists to work to prove one hypothesis in the cause of disproving another. Nor was the industry alone in its search for other causes of lung cancer that might work in tandem with smoking or even be the actual cause of the disease among smokers—“confounders” is the technical term. Moreover, because the question was so important, academic researchers were also busily searching for confounders. So couldn’t the industry’s research of half a century be seen in this light—as a legitimate effort to disprove the correlation of smoking and disease? The answer is a no. The millions of pages of Big Tobacco internal documents and studies that have come to light as a result of lawsuits demonstrate that the industry worked tirelessly for decades to promote only the studies that would support the preordained conclusions and suppress any findings that suggested otherwise.

A full decade passed between the landmark Hammond-Horn report and the even more important U.S. Surgeon General’s report of 1964, generally regarded as a turning point in the whole tobacco saga, the moment when the public, including smokers, had no choice but to see the light. A scientific consensus was reached. Forgotten is the fact that the report was actually a fairly moderate document, perhaps not surprisingly, as Big Tobacco was given the right to veto the appointments of the scientists on the report-writing committee. The report made the blunt statement that smoking was associated with a 70 percent increase in the age-specific death rates of males, but it corroborated the link between smoking and lung cancer for men only, as if women’s lungs might somehow be different.¹

Former Surgeon General C. Everett Koop, in his foreword to the important book *The Cigarette Papers*, deplored the “sleazy behavior of the tobacco industry in its attempts to discredit legitimate science as part of its overall effort to create controversy and doubt.” He plausibly suggested that the public health of the United States would have been much better if the industry had simply shared with the 1964 Surgeon General’s committee the scientific studies that it—and it alone—knew to be the best work available at the time.³⁹ Among the hundreds of secret industry documents cited in *The Cigarette Papers*, he might have been thinking of those in which executives of Brown and Williamson discussed considering passing along to the Surgeon General the results of its own “safe cigarette” research commissioned from a laboratory in Geneva. The basic idea in Switzerland was to find a carcinogen-free nicotine-delivery system. The study, titled “A Tentative Hypothesis on Nicotine Addiction,” lay

out the probable biochemical pathways that would explain the addictive properties of nicotine.⁴⁰ The addiction itself was never questioned. After judicious consideration, the company forwarded the incriminating study to the Tobacco Institute Research Committee and other industry bodies—but not to the Surgeon General of the United States.⁸

The following year, 1965, Congress passed legislation that required warning labels on all cigarette packages in the United States, another watershed and the first time any such label had been ordered for any retail product in the nation. However, this was no public health triumph; in fact, it was the opposite. The tobacco industry understood that warnings would have little effect on smokers. It used its powerful voice in Washington to craft legislation that ensured that cigarette marketing would continue unabated. In the same bill that required warning labels, Congress prohibited the Federal Trade Commission from regulating tobacco advertising and barred state and local governments from taking any action on cigarette labeling or advertising.^{41,42} Given the warnings now printed on every pack, smokers could hardly argue that they had been deceived by the cigarette makers. Many subsequent tobacco lawsuits turned on whether the disease predated the 1966 warning labels.

The industry would use the label for legal purposes while simultaneously denying the charges and muddying the waters at every opportunity. Perhaps my favorite of the many, many self-incriminating documents uncovered in the forty million pages now in the public domain (mostly as a result of a discovery during litigation; I have not read all of them, I admit) is the 1969 memo in which an executive gloated, “Doubt is our product since it is the best means of competing with the ‘body of fact’ that exists in the minds of the general public. It is also the means of establishing controversy.”⁴³

Another personal favorite is a letter dated 1972, in which a staffer for the Tobacco Institute wrote to a colleague that the strategy of the past twenty years or so—“litigation, politics, and public opinion”—had been “brilliantly conceived and executed” but was not “a vehicle for victory.” It was only a holding action, one based on “creating doubt about the health charge without actually denying it; advocating the public’s right to smoke, without actually urging them to take up the practice; encouraging objective scientific research as the only way to resolve the question of health hazard.”⁴⁴

There you have it: creating doubt about the health charge without actually denying it.

Workplace Cancer before OSHA

WAITING FOR THE BODY COUNT

Although not quite as infamous as the tobacco scandal, the asbestos cover-up of the past seventy years or so has been just as tragic in terms of lives diminished and lost. The “magic mineral” is a natural insulator against heat and flame. Currently it is also responsible for one hundred thousand deaths a year worldwide, according to the World Health Organization.¹ Paul Brodeur,²⁻⁴ Barry Castleman,⁵ and numerous others⁶⁻¹⁰ have documented in damning detail the industry’s denigration of the risks associated with asbestos exposure and its efforts over the decades to keep vital information out of the scientific literature and the popular press. No one—not even those subject to litigation today—defended the attitudes and actions of the original asbestos corporations. (Well, almost no one. Former Senate minority leader William Frist, a medical doctor, described the Johns-Manville Corporation and W. R. Grace and Company as “large, reputable companies that have gone bankrupt because of this crisis with the associated job losses” rather than as large, reputable companies that knowingly produced and sold a product that killed thousands of Americans.¹¹) As with the tobacco story, I will not retell the whole tragedy. I intend to focus on those aspects that involved the manipulation of science, as well as the absence of responsible corporate behavior in the period before the development of our regulatory system.

Asbestos is a bizarre mineral. It can be crushed into fibers and woven into cloth that is remarkably resistant to heat and fire. From ancient times, its uses were manifest—but so were its hazards. A Roman historian Pliny reports, the earliest producers understood that mining and working with asbestos fibers were deleterious to healthy breathing. With the coming of the industrial era, the uses of asbestos were even more manifest and more numerous—hundreds, perhaps thousands, of products contained and in some cases still contain asbestos—but this popularity only served to amplify the dangers. Perhaps the first authoritative acknowledgment of this downside in the industrial age was the Annual Report of Her Majesty’s Lady Inspectors. This British initiative, dated 1898, described in rather uncertain terms the “evil” that asbestos dust posed: “The worker falls into ill-health and sinks away out of sight in no sudden or sensational manner.”¹² Asbestos workers did not drop dead on the factory floor. Laboring to breathe, they just faded away—out of sight, out of mind—until a group of dedicated researchers and proselytizers brought this outrage to the world’s attention.

The sad—outrageous—fact is that the epidemiological research that proved the hazards of working with asbestos fibers had reached critical mass decades before virtually every major U.S. manufacturer entered bankruptcy, due mainly to large awards for damages made to asbestos disease victims and their families. There is little question that this enormous human and economic toll is the direct result of the industry’s obdurate, short-sighted program to deny the risks associated with exposure, to delay whenever possible protective regulation of workers, and to denigrate those who stepped forward to speak the truth. They played fast and loose with the science with a vengeance, and they reaped what they sowed, but only after thousands of workers had died.

One of the most famous documents cited by every chronicler of this story is the following admission by the chief actuary of the Prudential Life Insurance Company: “In the practice

American and Canadian life insurance companies asbestos workers are generally declined on account of the assumed health-injurious conditions of the industry.”¹³ The year was 1918. That early in the saga, the truth was officially out. Anyone in the industry who wanted to know about asbestos-related disease could have known, should have known—and almost certainly did know. By the thirties, the evidence was simply overwhelming. Why then didn’t the industry do something? The usual reason: did not have to. Workers’ compensation for occupational “dust diseases” (silicosis and asbestosis) was a rising concern for U.S. employers.⁵ Early on, therefore, executives must have decided that they had no choice but to keep plugging the holes in the dam because if it ever broke . . .

One famous smoking gun in the asbestos story comprises the 1934 letters from Vandiver Brown, attorney for Johns-Manville, then one of the world’s largest producers of asbestos products, to Dr. Anthony Lanza, the Metropolitan Life Insurance Company’s assistant medical director, who had conducted an industry-funded study about both asbestosis and silicosis, a separate lung disease caused by exposure to silica dust. At that time silicosis was perceived to be an even greater problem for the industry worldwide than was asbestosis. In the infamous Gauley Bridge tunnel episode early in the decade, hundreds of workers had been felled by silicosis—workers who would not have died had they used a “wet drilling” method to hold down the dust levels. Alas, that process slowed down the job, so the construction company used it only when inspectors were present.^{6,14} Following the Gauley Bridge episode, states began moving toward classifying silicosis as a compensable disease under the workers’ compensation programs. Therefore, the asbestos industry desperately wanted to distance its own asbestos problem from silicosis, and Brown asked Dr. Lanza to include in his published report the assertion that asbestosis was a much milder disease than silicosis.⁵ Early in his research Lanza had believed this was the case. By 1934 he knew that the opposite was more likely, as it has turned out to be.⁶

Writing to Lanza about suggested changes for the published report, Brown said, “I am sure that you understand that no one in our organization is suggesting that you alter by one jot or tittle any scientific facts or inevitable conclusions revealed or justified by your preliminary survey. All we ask is that all of the favorable aspects of the survey be included and that none of the unfavorable be intentionally pictured in darker tones than the circumstances justify. I feel confident that we can depend on you to give us this ‘break.’ ”⁶

Vandiver Brown was also in the middle of a dispute regarding the industry’s control over the animal studies it was funding at the Saranac Laboratory in upstate New York, the research facility of the Trudeau Sanatorium, the renowned tuberculosis treatment facility directed by the great-grandfather, grandfather, and then father of Garry Trudeau, the muckraking cartoonist who created “Doonesbury.”¹⁵ In 1936 Brown wrote Dr. Leroy Gardner, the director of the laboratory, “It is our further understanding that the results obtained will be considered the property of those who are advancing the required funds, who will determine whether, to what extent and in what manner the results shall be made public.”⁵

* * *

In 1938 Waldemar Dreessen led a team of U.S. Public Health Service (PHS) and state investigators in an epidemiological study of three asbestos textile plants in North Carolina. At the time, the PHS was a quiescent body that was unequipped in every way to face off with the companies.⁶ Unfortunately, the study was somewhat compromised by the fact that about 150 workers—more than one-quarter of the workforce—had been fired before the investigators showed up. Nor had these men and women been chosen for termination at random. They were the workers with the longest tenure in the plant and working in the most “exposed” jobs, therefore most likely to have asbestosis. Alerted to the deceit, the PHS was able to track down 69 of the fired employees. Forty-three had asbestosis. Hobbled as the

were by the management's scorched-earth employment policy, the investigators were still able to determine that of the workers who had been exposed to a total of 5-10 million particles per cubic foot (mppcf) for more than ten years, 68 percent had asbestosis. In many of the areas the PHS surveyed the exposure levels often rose to 5 or 10 or occasionally even 100 mppcf. No cases of asbestosis were seen among the few workers (5 in all) who were exposed to less than 5 mppcf for more than ten years.¹⁶

Dreessen recognized that the percentage of workers with asbestosis "increases greatly with increasing length of employment" and that virtually no one employed at these factories had been there more than 15 years. But averaging 5 mppcf per year, their careers would be short: perhaps 20 or 25 years. At some point in this time frame, they were likely to develop asbestosis.¹⁶

Yet Dreessen "tentatively" recommended a standard (then called a "threshold value") of 5.0. Why? He concluded that the industry could meet the 5.0 standard with the current technology, and since exposure above that level yielded indisputable disease, the government scientists could perhaps set that number to the industry.⁶ (This was three decades before the creation of the Occupational Safety and Health Administration [OSHA]). The Public Health Service had no enforcement power whatsoever. In fact, it could not even enter the plants without permission. Considering that many jobs in the industry exposed workers to levels many times higher than 5 mppcf, reasonable compliance with even that level would have been a public health triumph, relatively speaking. Nevertheless, it did not happen. No one bothers to argue that the 5.0 standard was effectively enforced or even monitored. What happened is that the American Conference of Governmental Industrial Hygienists, despite its name a private organization that made recommendations for voluntary exposure limits, adopted Dreessen's insufficient "tentative" standard in 1946, and it remained the only one, official or otherwise, enforced or unenforced, for more than twenty years. By then it was too late. An exposure limit that was far too lenient in the first place, combined with lax observance and enforcement, yielded the epidemic in asbestos disease with which we are dealing to this day.

In 1947 the Industrial Hygiene Foundation (a research group that worked for various employer trade associations) conducted a far-reaching study under the leadership of W. C. L. Hemeon, with the results intended for use only by its sponsor, the manufacturers who composed the Asbestos Textile Institute. Hemeon did not tell the ATI members what they wished to hear. He said the 5.0 exposure level was insufficiently researched and "does not permit complete assurance" of worker safety (emphasis original).¹⁷ Indeed it did not. In one of the factories surveyed, where the average exposure level was only 2.0 mppcf—less than half the operative standard—Hemeon found that 20 percent of the workers had asbestosis. Hemeon told the asbestos companies that "a new yardstick of accomplishment" needed to be found "[because] the elimination of future asbestosis depends on the degree of control effected now."¹⁷

Vandiver Brown, the in-house counsel for Johns-Manville, saw the results differently. He saw a golden opportunity to manufacture uncertainty. In a truly classic example of double-talking, he said in a speech at a Saranac Laboratory symposium, "So far as I have ever been able to ascertain, no one can state with certainty what is the maximum allowable limit for asbestos dust. I am certain no study has been made specifically directed toward ascertaining this figure and I question whether there exists sufficient data correlating the disease to the degree of exposure to warrant any determination that would even approximate accuracy."¹⁸

Follow the slippery logic here: Because the industry did not want to be held to any standard at all, it simply never conducted the studies that would have ascertained the proper standard. It would then use this self-imposed lack of "certainty" to defend itself against regulation and liability. (We will later see exactly the same ploy in other industries.)

The asbestos industry wanted nothing to do with cancer, which is exactly what the Saranac researchers and others started to find in the 1930s. Director Gardner was “startled” to discover that of eleven white mice inhaling asbestos dust for two years, nine developed pulmonary cancer.⁵ But the human evidence started appearing about the same time. Dr. Wilhelm Hueper, a German immigrant toxicologist who became a world-renowned expert in environmental carcinogenesis, identified the correlation between asbestosis and lung cancer in his classic text of 1942, *Occupational Tumors and Allied Disease*.¹⁹ By 1949 both the *Journal of the American Medical Association* and *Scientific American* had cited the evidence that asbestos is a carcinogen.^{20,21} Recognition of this relationship progressed faster in Europe; in fact, the wartime Nazi government made asbestos-induced lung cancer a compensable disease.²²

Following World War II, Johns-Manville pressured Saranac Laboratory to produce a report on the industry-funded research, which included the study with the white mice. The resulting report said not one word about cancer, while including a gratuitous—and utterly false—statement about the nonprogressive character of asbestosis.²³

In like fashion, the authors of a 1957 study on lung cancer among asbestos miners in Canada removed, at the request of the Quebec Asbestos Mining Association (QAMA), all reference to high rates of lung cancer found in workers with asbestosis. The authors of the study had suggested that one reason for the relatively high rate of cancers might have been the general underdiagnosis of asbestosis: the industry did not like the high cancer incidence, but it also did not like the underreporting hypothesis. Ultimately it failed to pursue either possibility.⁸

Apprised of the editorial decision to quash the cancer issue, Dr. Kenneth W. Smith, Johns-Manville’s medical director, filed this prescient (but obvious) caveat: “It must be recognized . . . that this report will be subjected to criticism when published because all other authors today correlate lung cancer and cases of asbestosis.”⁵ Wilhelm Hueper, chief of the National Cancer Institute’s Environmental Cancer Section, was the most prominent such voice. He derided the study’s “statistical acrobatics.”⁵ That Canadian study was cited by an oversight committee of the Asbestos Textile Institute as the reason for not funding its own comprehensive study. For one thing, they would receive the results from Canada. For another, as the committee stated in its minutes, “There is a feeling among certain members that such an investigation would stir up a hornet’s nest and put the whole industry under suspicion.” Finally, “We do not believe there is enough evidence of cancer or asbestosis, or cancer and asbestosis, in this industry to warrant this survey.”²⁴

A fascinating statement because this was not a document intended for the public; it was the “eyes only” minutes of a meeting. So these were people deceiving themselves. In 1957 no insider could have plausibly believed that last statement. Yet here it is. I believe that these asbestos executives needed to believe they were producing a safe product, so they pulled out all of the stops to convince not just the public but also themselves that this was the case. Comfortable within this self-delusion, they felt no hesitation to do whatever they could to defeat those people who were threatening their profits. Personal experience and observation also play a key role in these situations. Everyone knew asbestos-exposed workers who did not have asbestos-related disease, even after decades of exposure. It is just like cigarettes: “My grandfather smoked till he was eighty, and he was as strong as a bull, so it can’t be that harmful.” Epidemiological evidence involving statistics is harder to grasp. That is one reason there is always work for epidemiologists. However, the asbestos executives also ignored the obvious when it interfered with their worldview. I suspect this is how William Cooling, treasurer of Canada Asbestos Corporation, Ltd., viewed the world before dying at age sixty-three of mesothelioma, the almost always fatal cancer of the lining of the chest cavity or of the abdomen and whose only known

occupational cause is asbestos exposure.²⁵

By consensus, 1964 was the year in which the asbestos industry's decades-long cover-up fell apart (This was also the year of the landmark Surgeon General's report on smoking.²⁶) It did so almost overnight, at the historic Conference on the Biological Effects of Asbestos, organized for the New York Academy of Sciences by Dr. Irving Selikoff, of Mount Sinai Hospital.²⁷ Selikoff is the most prominent figure in the entire asbestos saga (perhaps in tandem with Paul Brodeur, whose lengthy article four years later in the *New Yorker* brought Dr. Selikoff and the asbestos scandal and crisis to national attention²⁸ and whose subsequent 1985 book, *Outrageous Misconduct*, is one of the seminal works in the field⁴).

Almost predictably, the industry tried to silence Dr. Selikoff. Immediately after the conference, industry lawyers wrote to him and urged caution in public discussion of the relationship between asbestos and mesothelioma. The letter discussed the "possibly damaging and misleading news stories that might be derived from the doctor's statements about asbestos and mesothelioma."²⁹

In 1967 Johns-Manville retained the public relations and consulting firm Hill and Knowlton, which thanks to its experience in defending tobacco, had much to offer the asbestos industry. The firm set up the Asbestos Information Association (AIA). Matt Swetonic, a Johns-Manville public relations staffer who would later become director of H&K's Division of Scientific, Technical, and Environmental Affairs and do extensive work for the tobacco industry, served as the AIA's first full-time executive secretary.^{30,31} Years later, when H&K was promoting its product defense expertise to industries facing regulatory challenges, the public relations firm summarized the approach it had developed for the asbestos companies. They advised the industry "to admit to the hazards of asbestos where they are demonstrable" (emphasis added).³² One wonders what advice they would give about any hazard about which there was even a small amount of uncertainty.

In this period, the industry emphasized a new defense of its business: The voluminous body of epidemiologic literature demonstrating asbestos's harmful effects does not pertain to asbestos products. Yes, the magic mineral does cause illness among workers processing the raw fiber, but retail products containing these fibers are perfectly safe. In 1968, for example, QAMA, the Canadian trade association, asserted that "Arising from recent press publicity, sometimes ill informed and exaggerated, widespread concern has been expressed, suggesting that the use of certain asbestos products might result in hazards to public health, such as lung cancer. These implications are natural of great concern to the asbestos industry and it would seem somewhat premature, to say the least, to accept theories of this sort, when not corroborated by unequivocal scientific evidence."³³

Whatever traction this argument might have had would be convincingly undermined by Dr. Selikoff's 1968 study of workers who installed asbestos insulation, whose lung cancer rate was seven times the expected number. This was also the study that established conclusively the powerfully synergistic impact of asbestos exposure combined with smoking. Asbestos workers with high exposures who also smoke have ninety times as many lung cancers as the nonsmoking population.³⁴ Both industries looked the other way—except when necessary in the courtroom, where, as we will see later in this chronicle, they might blame each other.

* * *

In the summer of 1979 I ran the program at the Montefiore Medical Center/ Albert Einstein College of Medicine in the Bronx that introduced medical students to occupational medicine. As part of the curriculum, we placed the first-year students with the International Chemical Workers Union, which represented workers at the old Calco Chemicals (later called American Cyanamid and now Wyeth) plant in Bound Brook, New Jersey. The workers at the factory manufactured, along with many other products, commercial dyes. The students' assignment was to investigate the hazards the workers face

and to design and implement an educational program to reduce these dangers.

~~Never allowed into the factory, we would meet with the workers in diners and parking lots. The~~ union members told us that the Raritan River downstream from the factory would run red some days, blue others, and green others, depending on the work product at the time. They also told us about the bladder cancers that were afflicting several of their coworkers and about their lawsuit against DuPont which produced the chemicals then used in the manufacture of the dyes. These chemicals are known generically as aromatic amines (not that they are particularly fragrant, but aromatic is what chemists call molecular structures that are based on the benzene ring). The workers' lawsuits had ended abruptly some years earlier, when DuPont's lawyers produced a letter dated 1947 from a medical director for the company warning the medical director of Calco of the hazards of beta-Naphthylamine (BNA), one of the chemicals in question. The workers' attorney told them DuPont would have been legally liable only if it had known or should have known of the risk posed by BNA and then failed to tell its customers. Since it had warned Calco of the dangers, their attorneys explained, DuPont was off the legal hook, and under workers' compensation laws, workers are barred from suing their employer. The men with bladder cancer would have to settle for workers' compensation payments, which would cover their medical bills and only a portion of their lost wages, with no payments for pain and suffering.

One of the workers gave us a copy of the DuPont letter, which contains information that, to my knowledge, had never been made public. The second paragraph begins this way: "The question of health control of employees in the manufacture of Beta Naphthylamine is indeed a grave one. As you know, we have manufactured Beta Naphthylamine for many years. Of the original group, who began the production of this product, approximately 100% have developed tumors of the bladder."³⁵

Now that is a smoking gun. Reading the letter for the first time, I stared in disbelief. I knew that the link between the aromatic amines and bladder cancer was well established, but I had never heard of any chemical that caused cancer in every one of a group of exposed workers. Could "100%" have been a typo? Should the number have been 10 percent, bad enough in itself? Either way, the admission by the medical director at DuPont demanded an investigation, and the more I learned, the more appalled I became. The number was not a mistake. The aromatic amines are killers, and the manufacturers knew this and did little until it was too late. In the annals of callous indifference to the health of industrial workers, this story is just as unseemly as the asbestos story, if less well known and affecting fewer people.

* * *

The saga begins in 1856, when William Henry Perkin, an eighteen-year-old British chemistry student, was attempting to synthesize quinine, a drug used throughout the British Empire to prevent malaria, from the coal tar that formerly had been a useless by-product of the distillation of coal to produce gas for lighting. Instead of quinine, however, Perkin came up with a delicate purple solution, which he named mauveine, which the French would shorten to mauve. His discovery became the first commercially feasible synthetic dye and the first of a series of scientific and industrial advances relating to dyes achieved in Europe in the second half of the nineteenth century, thereby creating an important new industry that provided the growing textile industry with bright and inexpensive colors.³⁶

Armed with the first patents, the English chemical industry dominated the global dye market—but not for long, as Germany rushed to catch up. Seeing an opportunity for sustained industrial development, the German government built formidable university laboratories to train scientists and provide the basic research the organic chemical industry needed—perhaps the earliest example of large-scale "industrial policy." With the private sector matching the government's efforts, German scientists soon obtained hundreds of patents. Their nation quickly surpassed the British and dominated

the market for decades.^{36,37}

The early dye industry was large and profitable, but its importance in economic history stems primarily from its relationship to the development of the synthetic organic chemical industry; aspirin, sulfa drugs, and phenolic resins were all derived from coal tar. The patents and production processes for the new dyes became the basis for the global expansion of organic chemical production, a vast and incalculably important contributor to modern industry and modern life.³⁸

However, a darker downside also existed: bladder cancer. The first cases among dye workers were diagnosed in 1895 by Ludwig Rehn, a surgeon in Frankfurt-am-Main, a center of the German chemical industry.³⁹ Rehn reported that three of the forty-five workers employed in the production of fuchsin, another early purple dye, developed bladder cancer, an exceedingly rare disease at the time. Ten years later he had identified thirty-eight workers with bladder cancer, and other physicians in Germany and Switzerland soon reported dozens of additional cases among dye workers.⁴⁰ In those initial reports the chemical or chemicals responsible for the cancer were the subject of speculation. Published reports consisted primarily of a listing of cases, accompanied by the names of the chemicals to which each worker was known to have been exposed. Over the course of several decades a consensus developed, as reported in the 1921 International Labour Organization (ILO) monograph *Cancer of the Bladder among Workers in Aniline Factories*. Examining the accumulated evidence, the ILO asserted that the chemicals most likely responsible for the cancer cases were benzidine and beta-naphthylamine. It urged “the most rigorous application of hygienic precautions” to prevent further cases from developing.⁴¹

On this side of the Atlantic, the United States also had a synthetic dye industry in the late 1800s, but these small-scale operators were dominated by the European chemical colossus, primarily because German and Swiss producers controlled virtually all of the important patents in the field. Then came the climactic months of World War I, when U.S. government officials accompanied the conquering U.S. Army into German manufacturing plants, seized their formulas and patents, and then distributed them at low cost to U.S. chemical companies. The recipients of these spoils of war, E. I. du Pont de Nemours and Company, Calco Chemicals, and Allied Chemical and Dye Corporation (later Allied Signal and now Honeywell) became the three largest synthetic dye producers in the United States, worthy rivals to their European competitors.⁴²

DuPont constructed its first organic chemicals factory in Deepwater, New Jersey, across the Delaware River from Wilmington, the center of its booming industrial empire.^{43,44} The plant would become known as the Chambers Works, after Arthur Chambers, the chemist who led DuPont's expansion into the dye industry.⁴⁴ Among the first chemicals produced there with the newly procured patents were benzidine and BNA. An internal DuPont document describes the workplace in 1911: “[BNA] was cast in open pans, broken with a pick, and transferred by hand into barrels, ground in an open mill, and shoveled by hand into operating equipment. There was no ventilation provided. Gross exposures occurred.”⁴⁵⁻⁴⁷

DuPont's physicians recognized the first bladder cancers among workers at the Chambers Works in 1932.⁴⁵ The cancers may have started appearing some years earlier,⁴⁸ but even if they did not, the date is irrelevant. The physicians and executives of all of the U.S. chemical companies were in regular direct contact with the dye producers of Central Europe and England. It was their job to know about the cancer cases in those countries. By 1932 the etiology, treatment, and prevention of the disease had already been discussed at length in numerous epidemiologic studies and review articles published in the medical journals of Britain, Germany, Switzerland, and Austria.^{36,40,49} Germany and Switzerland had even made bladder cancer among dye workers a compensable occupational disease in 1925.

Most important, the International Labour Organization had published its monograph on occupational bladder cancer in 1921, only a few years after DuPont began dye production at the Chambers Works. The explicit purpose of this report was to inform dye manufacturers around the world about the dangers posed by the production processes.⁴¹

Despite the wealth of information and warnings, DuPont allowed “gross exposures” to known carcinogens to go unabated for more than a decade at the Chambers Works. The company ultimately made some improvements to its operations in 1934, a few years after the beginning of a cancer epidemic, but significant levels of exposure were nevertheless allowed.⁴⁵ Recognizing that the chemicals it produced were extremely dangerous, that same year DuPont also established the Haskell Laboratory for Toxicology and Industrial Medicine, named after Harry Haskell, a DuPont executive who had started the firm’s medical division. The Haskell Laboratory remains one of the leading industrial toxicology laboratories in the world. It has supported a series of well-known researchers, the first of whom was Dr. Wilhelm Hueper.^{44,47}

Hueper joined DuPont in 1934, more than a year after writing an unsolicited memorandum to Irène du Pont, great-grandson of E. I. du Pont, suggesting that employees at the Deepwater plant were being exposed to known bladder carcinogens and were likely to develop cancer.⁵⁰ Early in his tenure as DuPont toxicologist, he requested permission to visit the Chambers Works. In his unpublished memoirs he recorded his shocked reaction at some length:

When the betanaphthylamine [BNA] experiment had been well under way for several months, I requested that I should be shown the incriminated operation in the Chambers Works, so that I could form an enlightened judgment of the occupational hazard. Several associates and I crossed the river a short time later to fulfill this task. The manager and some of his associates brought us first to the building housing this operation, which was located in a part of a much larger building. It was separated from other operations in the building by a large sliding-door allowing the ready spread of vapors, fumes and dust from the betanaphthylamine operation into the adjacent workrooms. Being impressed during this visit by the surprising cleanliness of the naphthylamine operation, which at that occasion was not actively working, I dropped back in the procession of visitors, until I caught up with the foreman at its end. When I told him ‘Your place is surprisingly clean,’ he looked at me and commented, ‘Doctor, you should have seen it last night; we worked all night to clean it up for you.’ The purpose of my visit was thereby almost completely destroyed. What I had been shown was a well-staged performance. I, therefore, approached the manager with the request to see the benzidine operation. After telling him what I just had been told, his initial reluctance to grant my request vanished and we were led a short distance up the road where the benzidine operation was housed in a separate small building. With one look at the place, it became immediately obvious how the workers became exposed. There was the white powdery benzidine on the road, the loading platform, the window sills, on the floor, etc. This revelation ended the visit. After coming back to Wilmington, I wrote a brief memorandum to Mr. Irene Du Pont describing to him my experience and my disappointment with the attempted deception. There was no answer but I was never allowed again to visit the two operations.⁵¹

Hueper and his Haskell lab colleagues were soon able to perfect the first experimental animal “model” for chemically induced bladder cancer.⁵² Meanwhile, the number of bladder cancers continued to grow, and by 1936 at least eighty-three cases had been diagnosed.⁵³ But despite the mounting evidence about the culpability of the DuPont operation—or perhaps because of the mounting evidence—Hueper’s disagreements with the company intensified, and he was not allowed to publish or present

data on his work.^{47,54}

It is quite likely that the rapid evolution—perhaps “devolution” is a more accurate description—DuPont’s policy on the role of scientific research in its chemical operations was influenced by an earlier episode of occupational disease at the Chambers Works, unrelated to dye production. In the early 1920s DuPont and General Motors, which at the time DuPont partly owned, had agreed to manufacture and distribute leaded gasoline, a product designed to reduce automobile engine knock. DuPont chose the Chambers Works for its production facility. The neurological effects of exposure to the organic lead were so severe and widespread—hallucinations were a common symptom—that workers labeled the plant the “House of Butterflies.” The New York Times reported that more than three hundred workers had been poisoned, eight of them fatally, during the first two years of production.^{55,56}

This may seem like ancient history, but to those workers still employed at Chambers, where they manufactured deadly organic lead for gasoline into the 1980s, it is not. While the most severe lead exposures were eventually controlled at the Chambers Works, the union representing the plant employees hired me in 1990 to represent them on a management-labor committee that was overseeing a new study of neurological effects among the lead-exposed workers. In that study, researchers from Johns Hopkins documented these effects among workers who were employed sixty years after their initial poisonings.^{57,58}

The national notoriety of the “House of Butterflies” scandal may have convinced DuPont that occupational disease epidemics would have to be handled differently in the future. Perhaps cover-up and denial would be better for the company, if not for the workers. In any event, the company fired Hueper in 1937, just three years after hiring him to do exactly what he did so splendidly: investigate the relationship between the aromatic amines and bladder cancer.^{51,54}

In 1940 the industrial giant considered additional improvements to reduce exposure to aromatic amines but decided to delay any changes, citing World War II as its excuse. No further improvements in the BNA production process were implemented until 1948. Total enclosure of the production line was finally completed in 1951, twenty years after the epidemic was recognized and thirty-plus years after production of the carcinogenic chemicals was begun with full knowledge of the dangers involved.^{45,59} The human toll was substantial: at least 450 Chambers Works employees have developed work-related bladder cancer.⁶⁰

After his dismissal, Dr. Hueper incorporated the DuPont research in his 1942 text *Occupational Tumors and Allied Diseases*, the most thorough review of world literature on occupational cancer to date.¹⁹ Outraged by the bladder cancer epidemic at the Chambers Works, Dr. Hueper initially wanted the dedication of the book to read “To the victims of cancer who made things for better living through chemistry”—a caustic allusion to DuPont’s well-known advertising slogan, “Better things for better living through chemistry.”⁵⁰ Perhaps fearful of the company’s retribution, in the end he dedicated the book “[t]o the memory of those of our fellow men who have died from occupational diseases contracted while making better things for an improved living for others.”⁴⁷

Hueper wrote later, with great bitterness, that he believed DuPont had attempted to undermine his scientific credibility and his ability to earn a living by denouncing him first as a Nazi and later as a Communist sympathizer.⁵¹ Any such attempt failed. Hueper served as chief of the National Cancer Institute’s Environmental Cancer Section from 1948 until 1964. His refusal to separate his scientific work from his crusade for a noncarcinogenic environment made him a lightning rod for controversy, but in addition to his groundbreaking work on occupational bladder cancer, he made important contributions in the study of air and water pollution, synthetic hydrocarbons, and food additives. His work provided much of the scientific basis for the “Delaney Clause,” as it is known, a 1958

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