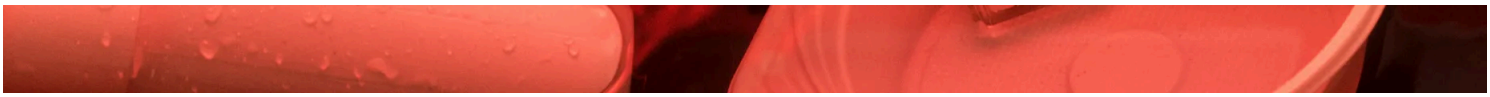
A REPORTER AT LARGE

HOW 3M DISCOVERED, THEN CONCEALED, THE DANGERS OF FOREVER CHEMICALS

The company found its own toxic compounds in human blood—and kept selling them.

By Sharon Lerner

May 20, 2024



In April, the Environmental Protection Agency finalized two historic regulations of forever chemicals, which are found in countless everyday products. Photo illustration by Philotheus Nisch for The New Yorker

This article is a collaboration between The New Yorker and ProPublica.

Kris Hansen had worked as a chemist at the 3M Corporation for about a year when her boss, an affable senior scientist named Jim Johnson, gave her a strange assignment. 3M had invented Scotch Tape and Post-it notes; it sold everything from sandpaper to kitchen sponges. But on this day, in 1997, Johnson wanted Hansen to test human blood for chemical contamination.

Several of 3M's most successful products contained man-made compounds called fluorochemicals. In a spray called Scotchgard, fluorochemicals protected leather and fabric from stains. In a coating known as Scotchban, they prevented food packaging from getting soggy. In a soapy foam used by firefighters, they helped extinguish jet-fuel fires. Johnson explained to Hansen that one of the company's fluorochemicals, PFOS—short for perfluorooctanesulfonic acid—often found its way into the bodies of 3M factory workers. Although he said that they were unharmed, he had recently hired an outside lab to measure the levels in their blood. The lab had just reported something odd, however. For the sake of comparison, it had tested blood samples from the American Red Cross, which came from the general population and should have been free of fluorochemicals. Instead, it kept finding a contaminant in the blood.

Johnson asked Hansen to figure out whether the lab had made a mistake. Detecting trace levels of chemicals was her specialty: she had recently written a doctoral dissertation about tiny particles in the atmosphere. Hansen's team of lab technicians and junior scientists fetched a blood sample from a lab-supply company and prepped it for analysis. Then Hansen switched on an oven-size box known as a mass spectrometer, which weighs molecules so that scientists can identify them.

As the lab equipment hummed around her, Hansen loaded a sample into the machine. A graph appeared on the mass spectrometer's display; it suggested that there was a compound in the blood that could be PFOS. That's weird, Hansen thought. Why would a chemical produced by 3M show up in people who had never worked for the company?

Hansen didn't want to share her results until she was certain that they were correct, so she and her team spent several weeks analyzing more blood, often in time-consuming overnight tests. All the samples appeared to be contaminated. When Hansen used a more precise method, liquid chromatography, the results left little doubt that the chemical in the Red Cross blood was PFOS.

Hansen now felt obligated to update her boss. Johnson was a towering, bearded man, and she liked him: he seemed to trust her expertise, and he found something to laugh about in most conversations. But, when she shared her findings, his response was cryptic. "This changes everything," he said. Before she could ask him what he meant, he went into his office and closed the door.

This was not the first time that Hansen had found a chemical where it didn't belong. A wiry woman who grew up skiing competitively, Hansen had always liked to spend time outdoors; for her chemistry thesis at Williams College, she had kayaked around the former site of an electric company on the Hoosic River, collecting crayfish and testing them for industrial pollutants called polychlorinated biphenyls (PCBs). Her research, which showed that a drainage ditch at the site

was leaking the chemicals, prompted a news story and contributed to a cleanup effort overseen by the Massachusetts Department of Environmental Protection. At 3M, Hansen assumed that her bosses would respond to her findings with the same kind of diligence and care.

Hansen stayed near Johnson's office for the rest of the day, anxiously waiting for him to react to her research. He never did. In the days that followed, Hansen sensed that Johnson had notified some of his superiors. She remembers his boss, Dale Bacon, a paunchy fellow with gray hair, stopping by her desk and suggesting that she had made a mistake. "I don't think so," she told him. In subsequent weeks, Hansen and her team ordered fresh blood samples from every supplier that 3M worked with. Each of the samples tested positive for PFOS.

In the middle of this testing, Johnson suddenly announced that he would be taking early retirement. After he packed up his office and left, Hansen felt adrift. She was so new to corporate life that her office clothes—pleated pants and dress shirts—still felt like a costume. Johnson had always guided her research, and he hadn't told Hansen what she should do next. She reminded herself of what he had said—that the chemical wasn't harmful in factory workers. But she couldn't be sure that it was harm*less*. She knew that PCBs, for example, were mass-produced for years before studies showed that they accumulate in the food chain and cause a range of health issues, including damage to the brain. The most reliable way to gauge the safety of chemicals is to study them over time, in animals and, if possible, in humans.

What Hansen didn't know was that 3M had already conducted animal studies—two decades earlier. They had shown PFOS to be toxic, yet the results remained secret, even to many at the company. In one early experiment, conducted in the late seventies, a group of 3M scientists fed PFOS to rats on a daily basis. Starting at the second-lowest dose that the scientists tested, about ten milligrams for every kilogram of body weight, the rats showed signs of possible harm to their livers, and half of them died. At higher doses, every rat died. Soon afterward, 3M scientists found that a relatively low daily dose, 4.5 milligrams for every kilogram of body weight, could kill a monkey within weeks. (Based on this result, the chemical would currently fall into the highest of five toxicity levels recognized by the United Nations.) This daily dose of PFOS was orders of magnitude greater than the amount that the average person would ingest, but it was still relatively low—roughly comparable to the dose of aspirin in a standard tablet.

In 1979, an internal company report deemed PFOS "certainly more toxic than anticipated" and recommended longer-term studies. That year, 3M executives flew to San Francisco to consult Harold Hodge, a respected toxicologist. They told Hodge only part of what they knew: that PFOS had sickened and even killed laboratory animals, and had caused liver abnormalities in factory workers. According to a 3M document that was marked "CONFIDENTIAL," Hodge urged the executives to study whether the company's fluorochemicals caused reproductive issues or cancer. After reviewing more data, he told one of them to find out whether the chemicals were present "in man," and he added, "If the levels are high

and widespread and the half-life is long, we could have a serious problem." Yet Hodge's warning was omitted from official meeting notes, and the company's fluorochemical production increased over time.

Hansen's bosses never told her that PFOS was toxic. In the weeks after Johnson left 3M, however, she felt that she was under a new level of scrutiny. One of her superiors suggested that her equipment might be contaminated, so she cleaned the mass spectrometer and then the entire lab. Her results didn't change. Another encouraged her to repeatedly analyze her syringes, bags, and test tubes, in case they had tainted the blood. (They had not.) Her managers were less concerned about PFOS, it seemed to Hansen, than about the chance that she was wrong.

Sometimes Hansen doubted herself. She was twenty-eight and had only recently earned her Ph.D. But she continued her experiments, if only to respond to the questions of her managers. 3M bought three additional mass spectrometers, which each cost more than a car, and Hansen used them to test more blood samples. In late 1997, her new boss, Bacon, even had her fly out to the company that manufactured the machines, so that she could repeat her tests there. She studied the blood of hundreds of people, from more than a dozen blood banks in various states. Each sample contained PFOS. The chemical seemed to be everywhere.

When 3M was founded, in 1902, it was known as the Minnesota Mining and Manufacturing Company. After its mining operations flopped, the company pivoted to sandpaper, and then to a series of clever inventions aimed at improving everyday life. An early employee noticed that autoworkers were struggling to paint two-tone cars, which were popular at the time; he eventually invented masking tape, using crêpe paper and cabinetmaker's glue. Another 3M employee created Post-it notes, to help him bookmark passages in his church hymnal. An official history of 3M, published for the company's hundredth anniversary, celebrated its "tolerance for tinkerers."

Fluorochemicals had their origins in the American effort to build the atomic bomb. During the Second World War, scientists for the Manhattan Project developed one of the first safe processes for bonding carbon to fluorine, a dangerously reactive element that experts had nicknamed "the wildest hellcat" of chemistry. After the war, 3M hired some Manhattan Project chemists and began mass-producing chains of carbon atoms bonded to fluorine atoms. The resulting chemicals proved to be astonishingly versatile, in part because they resist oil, water, and heat. They are also incredibly long-lasting, earning them the moniker "forever chemicals."

In the early fifties, 3M began selling one of its fluorochemicals, PFOA, to the chemical company DuPont, for use in Teflon. Then, a couple of years later, a dollop of fluorochemical goo landed on a 3M employee's tennis shoe, where it proved impervious to stains and impossible to wipe off. 3M now had the idea for Scotchgard and Scotchban. By the time Hansen was in elementary school, in the seventies, both products were ubiquitous. Restaurants served French fries in Scotchban-treated packaging. Hansen's mother sprayed Scotchgard on the living-room couch.

Hansen grew up in Lake Elmo, Minnesota, not far from 3M's headquarters. Her father was one of the company's star engineers and was even inducted into its hall of fame, in 1979; he had helped to create Scotch-Brite scouring pads and Coban wrap, a soft alternative to sticky bandages. Once, he molded some fibres into cups, thinking that they might make a good bra. They turned out to be miserably uncomfortable, so he and his colleagues placed them over their mouths, giving the company the inspiration for its signature N95 mask.

Hansen never intended to follow her father to the company. She spent her childhood summers catching turtles and leopard frogs at the lake and hoped to have a career in environmental conservation. Her first job after earning her chemistry Ph.D. was on a boat, which took her to remote parts of the Pacific Ocean. But the voyage left her so seasick that she lost twenty pounds, and she

soon retreated to Minnesota. In 1996, at her father's suggestion, Hansen applied for a position in 3M's environmental lab.

After Hansen started her PFOS research, her relationships with some colleagues seemed to deteriorate. One afternoon in 1998, a trim 3M epidemiologist named Geary Olsen arrived with several vials of blood and asked her to test them. The next morning, she read the results to him and several colleagues—positive for PFOS. As Hansen remembers it, Olsen looked triumphant. "Those samples came from my horse," he said—and his horse certainly wasn't eating at McDonald's or trotting on Scotchgarded carpets. Hansen felt that he was trying to humiliate her. (Olsen did not respond to requests for comment.) What Hansen wanted to know was how PFOS was making its way into animals.

She found an answer in data from lab rats, which also appeared to have fluorochemicals in their blood. Rats that had more fish meal in their diets, she discovered, tended to have higher levels of PFOS, suggesting that the chemical had spread through the food chain, and perhaps through water. In male lab rats, PFOS levels rose with age, indicating that the chemical accumulated in the body. But, curiously, in female rats the levels sometimes fell. Hansen was unsettled when toxicology reports indicated why: mother rats seemed to be off-loading the chemical to their pups. Exposure to PFOS could begin before birth.

Another study confirmed that Scotchban and Scotchgard were sources of the chemical. PFOS wasn't an official ingredient in either product, but both contained other fluorochemicals that, the study showed, broke down into PFOS in the bodies of lab rats. Hansen and her team ultimately found PFOS in eagles, chickens, rabbits, cows, pigs, and other animals. They also found fourteen additional fluorochemicals in human blood, including several produced by 3M. Some were present in wastewater from a 3M factory.

At one point, Hansen told her father, Paul, that she was frustrated by the way senior colleagues kept questioning her work. Paul had recently retired, but he had

confidence in 3M's top executives, and he suggested that she take her findings directly to them. But as a relatively new employee—and one of the few women scientists at a company of about seventy-five thousand people—Hansen found the idea preposterous. When Paul offered to talk to some of 3M's executives himself, she was mortified at the idea of her father interceding.

Hansen knew that if she could find a blood sample that *didn't* contain PFOS then she might be able to convince her colleagues that the other samples did. She and her team began to study historical blood from the early decades of PFOS production. They soon found the chemical in blood from a 1969-71 Michigan breast-cancer study. Then they ran an overnight test on blood that had been collected in rural China during the eighties and nineties. If any place were PFOS-free, she figured, it would be somewhere remote, where 3M products weren't in widespread use.

The next morning, anxious to see the results, Hansen arrived at the lab before anyone else. For the first time since she had begun testing blood, some of the samples showed no trace of PFOS. She was so struck that she called her husband. There was nothing wrong with her equipment or methodology; PFOS, a man-made chemical produced by her employer, really *was* in human blood, practically everywhere. Hansen's team found it in Swedish blood samples from 1957 and 1971. After that, her lab analyzed blood that had been collected before 3M created PFOS. It tested negative. Apparently, fluorochemicals had entered human blood after the company started selling products that contained them. They had leached out of 3M's sprays, coatings, and factories—and into all of us.

That summer, an in-house librarian at 3M delivered a surprising article to Hansen's office mailbox. It had been written in 1981, by 3M scientists, and it described a method for measuring fluorine in blood, indicating that even back then the company was testing for fluorochemicals. One scientist mentioned in the

article, Richard Newmark, still worked for 3M, in a low-lying structure nicknamed the "nerdy building." Hansen arranged to meet with him there.

Newmark, a collegial man with a compact build, told Hansen that, more than twenty years before, two academic scientists, Donald Taves and Warren Guy, had discovered a fluorochemical in human blood. They had wondered whether Scotchgard might be its source, so they approached 3M. Newmark told her that his subsequent experiments had confirmed their suspicions—the chemical was PFOS—but 3M lawyers had urged his lab not to admit it.

As Hansen wrote all this down in a notebook, she felt anger rising inside her. Why had so many colleagues doubted the soundness of her results if earlier 3M experiments had already proved the same thing? After the meeting, she hurried back to the lab to find Bacon. "He knew!" she told him.

Bacon's face remained expressionless. He told Hansen to type up her notes for him. She remembers him telling her not to e-mail them. (In response to questions about Hansen's account, Bacon said that he didn't remember specifics. When I called Newmark, he told me that he could not remember her or anything about PFOS. "It's been a very long time, and I'm in my mid-eighties, and just do not remember stuff that well," he said.)

A few months later, in early 1999, Bacon invited Hansen to an extraordinary meeting: she would have the chance to present her findings to 3M's C.E.O., Livio D. DeSimone. Hansen spent several days rehearsing while driving and making dinner. On the day of the meeting, she took an elevator up to the executive suite; her stomach turned as a secretary pointed her to a conference room. Men in suits sat around a long table. Her boss, Bacon, was there. DeSimone, a portly man with white hair, sat at the head of the table.

Almost as soon as Hansen placed her first transparency on the projector, the attendees began interrogating her: Why did she do this research? Who directed her to do it? Whom did she inform of the results? The executives seemed to view her diligence as a betrayal: her data could be damaging to the company. She remembers defending herself, mentioning Newmark's similar work in the seventies, and trying, unsuccessfully, to direct the conversation back to her research. While the executives talked over her, Hansen noticed that DeSimone's eyes had closed and that his chin was resting on his dress shirt. The C.E.O. appeared to have fallen asleep. (DeSimone died in 2017. A company spokesperson did not answer my questions about the meeting.)

After that meeting, Hansen remembers learning from Bacon that her job would be changing. She would only be allowed to do experiments that a supervisor had specifically requested, and she was to share her data with only that person. She would spend most of her time analyzing samples for studies that other employees were conducting, and she should not ask questions about what the results meant. Several members of her team were also being reassigned. Bacon explained that a different scientist at 3M would lead research into PFOS going forward. Hansen felt that she was being punished and struggled not to cry.

Even as Hansen was being sidelined, the results of her research were quietly making their way into the files of the Environmental Protection Agency. Since the seventies, federal law has required that companies tell the E.P.A. about any

evidence indicating that a company's products present "a substantial risk of injury to health or the environment." In May, 1998, 3M officials notified the agency, without informing Hansen, that the company had measured PFOS in blood samples from around the U.S.—a clear reference to Hansen's work. It did not mention its animal research from the seventies, and it said that the chemical caused "no adverse effects" at the levels the company had measured in its workers. A year later, 3M sent the E.P.A. another letter, again without telling Hansen. This time, it informed the agency about the fourteen other fluorochemicals, several of them made by 3M, that Hansen's team had detected in human blood. The company reiterated that it did not believe that its products presented a substantial risk to human health.

Hansen recalls that in the summer of 1999, at an annual picnic that her parents hosted for 3M scientists, she was grilling corn when one of the creators of Scotchgard, a gray-haired man in glasses, confronted her. He accused her of trying to tear down the work of her colleagues. Did it make her feel powerful ruining other people's careers? he asked. Hansen didn't know how to respond, and he walked away.

Several of Hansen's superiors had stopped greeting her in the hallways. When she presented a poster of her research at a 3M event, nobody asked her about it. She lost her appetite, and her pleated pants grew baggy. She started to worry that an angry co-worker might confront or even harm her in the company's dark parking lot. She got into the habit of calling her husband before walking to her car.

A year after Hansen's meeting with the C.E.O., 3M, under pressure from the E.P.A., made a very costly decision: it was going to discontinue its entire portfolio of PFOS-related chemicals. In May, 2000, for the first time, 3M officials revealed to the press that it had detected the chemical in blood banks. One executive claimed that the discovery was a "complete surprise." The company's medical director told the New York *Times*, "This isn't a health issue now, and it won't be a health issue." But the newspaper also quoted a professor of toxicology. "The real

issue is this stuff accumulates," the professor said. "No chemical is totally innocuous, and it seems inconceivable that anything that accumulates would not eventually become toxic."

Hansen was now pregnant with twins. Although she was heartened by 3M's announcement—she saw it as evidence that her work had forced the company to act—she was also ready to leave the environmental lab, where she felt marginalized. After giving birth, she joined 3M's medical-devices team. But, first, she decided to have one last blood sample tested for PFOS: her own. The results showed one of the lowest readings she'd seen in human blood. Immediately, she thought of the rats that had passed the chemical on to their pups.

Hansen told me that, for the next nineteen years, she avoided the subject of fluorochemicals with the same intensity with which she had once pursued it. She focussed on raising her kids and coaching a cross-country ski team; she worked a variety of jobs at 3M, none related to fluorochemicals. In 2002, when 3M announced that it would be replacing PFOS with another fluorochemical, PFBS, Hansen knew that it, too, would remain in the environment indefinitely. Still, she decided not to involve herself. She skipped over articles about the chemicals in scientific journals and newspapers, where they were starting to be linked to possible developmental, immune-system, and liver problems. (In 2006, after the E.P.A. accused 3M of violating the Toxic Substances Control Act, in part by repeatedly failing to disclose the harms of fluorochemicals promptly, the company agreed to pay a small penalty of $1.5 million, without admitting wrongdoing.)

During that time, forever chemicals gained a new scientific name—per- and polyfluoroalkyl substances, or PFAS, an acronym that is vexingly similar to the specific fluorochemical PFOS. A swath of a hundred and fifty square miles around 3M's headquarters was found to be polluted with PFAS; scientists discovered PFOS and PFBS in local fish, and various fluorochemicals in water that roughly a hundred and twenty-five thousand Minnesotans drank. Hansen's husband, Peter,

told me that, when friends asked Hansen about PFAS, she would change the subject. Still, she repeatedly told him—and herself—that the chemicals were safe.

In the 2016 book "Secrecy at Work," two management theorists, Jana Costas and Christopher Grey, argue that there is nothing inherently wrong or harmful about keeping secrets. Trade secrets, for example, are protected by federal and state law, on the ground that they promote innovation and contribute to the economy. The authors draw on a large body of sociological research to illustrate the many ways that information can be concealed. An organization can compartmentalize a secret by slicing it into smaller components, preventing any one person from piecing together the whole. Managers who don't want to disclose sensitive information may employ "stone-faced silence." Secret-keepers can form a kind of tribe, dependent on one another's continued discretion; in this way, even the existence of a secret can be kept secret. Such techniques become pernicious, Costas and Grey write, when a company keeps a dark secret, a secret about wrongdoing.

Certain unpredictable events—a leak, a lawsuit, a news story—can start to unspool a secret. In the case of forever chemicals, the unspooling began on a cattle farm. In 1998, a West Virginia farmer told a lawyer, Robert Bilott, that wastewater from a DuPont site seemed to be poisoning his cows: they had started to foam at the mouth, their teeth grew black, and more than a hundred eventually fell over and died. Bilott sued and obtained tens of thousands of internal documents, which helped push forever chemicals into the public consciousness. The documents revealed that the farm's water contained PFOA, the fluorochemical that DuPont had bought from 3M, and that both companies had long understood it to be toxic. (The lawsuit, which ended in a settlement, was dramatized in the film "Dark Waters," starring Mark Ruffalo as Bilott.) Bilott later sued 3M over contamination in Minnesota, but the judge prohibited discussion of health repercussions; a jury ultimately decided in 3M's favor. Finally, in 2010, the Minnesota attorney general's

office filed its own suit, alleging that 3M had harmed the environment and polluted drinking water. The company paid eight hundred and fifty million dollars in a settlement, without an admission of fault or liability. The A.G. also released thousands more internal 3M records to the public.

The A.G.'s records helped me report a series of stories for the Intercept about forever chemicals. Much of my reporting, which started in 2015, focussed on what 3M and DuPont knew, even as they continued to produce PFAS. But, as I reported on the coverup, I wondered what it meant for a sprawling multinational company to *know* that its products were dangerous. Who knew? How much, exactly, did they know? And how had the company kept its secret? For many years, no one inside 3M would agree to speak with me.

Then, in 2021, John Oliver did a segment on his comedy news show, "Last Week Tonight," about forever chemicals. The segment, which mentioned my reporting, said that they could cause cancer, immune-system issues, and other problems. "The world is basically soaked in the Devil's piss right now," Oliver said. "And not in a remotely hot way." One of Hansen's former professors sent her the segment, and Hansen watched it at her kitchen table—a moment that would eventually lead her to me.

"This actually made me sad as there are so many inaccuracies," Hansen wrote to her professor, in response. But, when the professor asked her what was incorrect, Hansen didn't know what to say. For the first time, she Googled the health effects of PFOS.

Hansen was deeply troubled by what she read. One paper, published in 2012 in the *Journal of the American Medical Association*, found that, in children, as PFOS levels rose so did the chance that vaccines were ineffective. Children with high levels of PFOS and other fluorochemicals were more likely to experience fevers, according to a 2016 study. Other research linked the chemicals to increased rates of infectious diseases, food allergies, and asthma in children. Dozens of scientific papers had found that, in adults, even very low levels of PFOS could interfere with

hormones, fertility, liver and thyroid function, cholesterol levels, and fetal development. Even PFBS, the chemical that 3M chose as a replacement for PFOS, caused developmental and reproductive irregularities in animals, according to the Minnesota Department of Health.

Reading these studies, Hansen felt a paradoxical kind of relief: as bad as PFOS seemed to be, at least independent scientists were studying it. But she also felt enraged at the company, and at herself. For years, she had repeated the company's claim that PFOS was not harmful. "I'm not proud of that," she told me. She felt "dirty" for ever collecting a 3M paycheck. When she read the documents released by the Minnesota A.G., she was horrified by how much the company had known, and how little it had told her. She found records of studies that she had conducted, as well as the typed notes from her meeting with Newmark.

In October, 2022, after Hansen had been at 3M for twenty-six years, her job was eliminated, and she chose not to apply for a new one. Three months later, she wrote me an e-mail, offering to speak about what she had witnessed inside the company. "If you'd be interested in talking further, please let me know," she wrote. The next day, we had the first of dozens of conversations.

When Hansen first told me about her experiences, I felt conflicted. Her work seemed to have helped force 3M to stop making a number of toxic chemicals, but I kept thinking about the twenty years in which she had kept quiet.

During my first visit to Hansen's home, in February, 2023, we sat in her kitchen, eating bread that her husband had just baked. She showed me pictures of her father and shared a color-coded time line of 3M's history with forever chemicals. On a bitterly cold walk in a local park, we tried to figure out if any of her colleagues, besides Newmark, had known that PFOS was in everyone's blood. She often sprinkled her stories with such Midwesternisms as "holy buckets!"

During my second trip, this past August, I asked her why, as a scientist who was trained to ask questions, she hadn't been more skeptical of claims that PFOS was harmless. In the awkward silence that followed, I looked out the window at some hummingbirds.

Hansen's superiors had given her the same explanation that they gave journalists, she finally said—that factory workers were fine, so people with lower levels would be, too. Her specialty was the detection of chemicals, not their harms. "You've got literally the medical director of 3M saying, 'We studied this, there are no effects,' " she told me. "I wasn't about to challenge that." Her income had helped to support a family of five. Perhaps, I wondered aloud, she hadn't really wanted to know whether her company was poisoning the public.

To my surprise, Hansen readily agreed. "It almost would have been too much to bear at the time," she told me. 3M had successfully compartmentalized its secret; Hansen had only seen one slice. (When I sent the company detailed questions about Hansen's account, a spokesperson responded without answering most of them or mentioning Hansen by name.)

Recently, I thought back on Taves and Guy, the academic scientists who, in the seventies, came so close to proving that 3M's chemicals were accumulating in humans. Taves is ninety-seven, but when I called him he told me that he still remembers clearly when company representatives visited his lab at the University of Rochester. "They wanted to know everything about what we were doing," he told me. But the exchange was not reciprocal. "I soon found out that they weren't

going to tell me anything." 3M never confirmed to Taves or Guy, who was a postdoctoral student at the time, that its fluorochemicals were in human blood. "I'm sort of kicking myself for not having followed up on this more, but I didn't have any research money," Guy told me. He eventually became a dentist to support his wife and family. (He died this year, at eighty-one.) Taves, too, left the field, to become a psychiatrist, and the trail ended there.

Last year, while reading about the thousands of PFAS-related lawsuits that 3M was facing, I was intrigued to learn that one of them, filed by cities and towns with polluted water, had produced a new set of internal 3M documents. When I requested several from the plaintiff's legal team, I saw two names that I recognized. In a document from 1991, a 3M scientist talked about using a mass spectrometer—the same tool that Hansen would use years later—to devise a technique for measuring PFOS in biological fluid. The author was Jim Johnson—and he had sent the report to his boss, Dale Bacon.

This revelation made me gasp. Johnson had been Hansen's first boss and had instigated her research into PFOS. Bacon had questioned her findings and ultimately told her to stop her work. (In a sworn deposition, Bacon said that by the eighties he had heard, during a water-cooler chat with a colleague, that Taves and Guy had found PFOS in human blood.) What I couldn't understand was why Johnson would ask Hansen to investigate something that he had already studied himself—and then act surprised by the results.

Jim Johnson, who is now an eighty-one-year-old widower, lives with several dogs in a pale-yellow house in North Dakota. When I first called him, he said that he had begun researching PFOS in the seventies. "I did a lot of the very original work on it," he told me. He said that when he saw the chemical's structure he understood "within twenty minutes" that it would not break down in nature. Shortly thereafter, one of his experiments revealed that PFOS was binding to proteins in the body, causing the chemical to accumulate over time. He told me

that he also looked for PFOS in an informal test of blood from the general population, around the late seventies, and was not surprised when he found it there.

Johnson initially cited "four hundred and eighty pounds of dog" as a reason that I shouldn't visit him, but he later relented. When I arrived, on a chilly day in November, we spent a few minutes standing outside his house, watching Snozzle, Sadie, and Junkyard press their slobbery snouts against his living-room window. Then we decamped to the nearest IHOP. Johnson, who was dressed in jeans and a flannel shirt, was so tall that he couldn't comfortably fit into a booth. We sat at a table and ordered two bottomless coffees.

In an experiment in the early eighties, Johnson fed a component of Scotchban to rats and found that PFOS accumulated in their livers, a result that suggested how the chemical would behave in humans. When I asked why that mattered to the company, he took a sip of coffee and said, "It meant they were screwed."

At the time, Johnson said, he didn't think PFOS caused significant health problems. Still, he told me, "it was obviously bad," because man-made compounds from household products didn't belong in the human body. He said that he argued against using fluorochemicals in toothpaste and diapers. Contractors working for 3M had shaved rabbits, he said, and smeared them with the company's fluorochemicals to see if PFOS showed up in their bodies. "They'd send me the livers and, yup, there it was," he told me. "I killed a lot of rabbits." But he considered his efforts largely futile. "These idiots were already putting it in food packaging," he said.

Johnson told me, with seeming pride, that one reason he didn't do more was that he was a "loyal soldier," committed to protecting 3M from liability. Some of his assignments had come directly from company lawyers, he added, and he couldn't discuss them with me. "I didn't even report it to my boss, or anybody," he said. "There are some things you take to your grave." At one point, he also told me that,

if he were asked to testify in a PFOS-related lawsuit, he would probably be of little help. "I'm an old man, and so I think they would find that I got extremely forgetful all of a sudden," he said, and chuckled.

Out the windows of IHOP, I watched a light dusting of snow fall on the parking lot. In Johnson's telling, a tacit rule prevailed at 3M: not all questions needed to be asked, or answered. His realization that PFOS was in the general public's blood "wasn't something anyone cared to hear," he said. He wasn't, for instance, putting his research on posters and expecting a warm reception. Over the years, he tried to convince several executives to stop making PFOS altogether, he told me, but they had good reason not to. "These people were selling fluorochemicals," he said. He retired as the second-highest-ranked scientist in his division, but he claimed that important business decisions were out of his control. "It wasn't for me to jump up and start saying, 'This is bullshit!' " he said, and he was "not really too interested in getting my butt fired." And so his portion of 3M's secret stayed in a compartment, both known and not known.

Johnson said that he eventually tired of arguing with the few colleagues with whom he could speak openly about PFOS. "It was time," he said. So he hired an outside lab to look for the chemical in the blood of 3M workers, knowing that it would also test blood-bank samples, for comparison—the first domino in a chain that would ultimately take the compound off the market. Oddly, he compared the head of the lab to a vending machine. "He gave me what I paid for," Johnson said. "I knew what would happen." Then Johnson tasked Hansen with something that he had long avoided: going beyond his initial experiments and meticulously documenting the chemical's ubiquity. While Hansen took the heat, he took early retirement.

Johnson described Hansen as though she were a vending machine, too. "She did what she was supposed to do with the tools I left her," he said.

I pointed out that Hansen had suffered professionally and personally, and that she now feels those experiences tainted her career. "I didn't say I was a nice guy,"

Johnson replied, and laughed. After four hours, we were nearing the bottom of our bottomless coffees.

Johnson has strayed from evidence-based science in recent years. He now believes, for instance, that the theory of evolution is wrong, and that COVID-19 vaccines cause "turbo-cancers." But his account of what happened at 3M closely matched Hansen's, and when I asked him about meetings and experiments described in court documents he remembered them clearly.

As a scientist at 3M, Kris Hansen found her company's chemicals in the blood of the general public. Her superiors did not tell her that they were toxic. Photograph by Haruka Sakaguchi

When I called Hansen about my conversation with Johnson, she grew angrier than I'd ever heard her. "He knew the whole time!" she said. Then she had to get

off the phone for an appointment. “So glad I’m going to see my therapist,” she added, and hung up.

I once thought of secrets as discrete, explosive truths that a heroic person could suddenly reveal. In the 1983 film “Silkwood,” which is based on real events, Karen Silkwood, a worker at a plutonium plant, assembles a thick folder documenting her employer’s shoddy safety practices; while driving to share them with a reporter, she dies in a mysterious one-car crash. In another adaptation of a true story, the 2015 film “Spotlight,” a source delivers a box of critical documents to the Boston *Globe*, helping the paper to publish an investigation into child sexual abuse within the Catholic Church. Talking to Hansen and Johnson, though, I saw that the truth can come out piecemeal over many years, and that the same people who keep secrets can help divulge them. Some slices of 3M’s secret are only now coming to light, and others may never come out.

Between 1951 and 2000, 3M produced at least a hundred million pounds of PFOS and chemicals that degrade into PFOS. This is roughly the weight of the Titanic. After the late seventies, when 3M scientists established that the chemical was toxic in animals and was accumulating in humans, it produced millions of pounds per year. Scientists are still struggling to grasp all the biological consequences. They have learned, just as Johnson did decades ago, that proteins in the body bind to PFOS. It enters our cells and organs, where even tiny amounts can cause stress and interfere with basic biological functions. It contributes to diseases that take many years to develop; at the time of a diagnosis, one’s PFOS level may have fallen, making it difficult to establish causation with any certainty.

The other day, I called Brad Creacey, who became an Air Force firefighter in the seventies, at the age of eighteen. He told me that several times a year, for practice, he and his comrades put on rubber boots and heavy silver uniforms that looked like spacesuits. Then a “torch man,” holding a stick tipped with a burning rag, ignited jet fuel that had been poured into an open-air pit. To extinguish the

hundred-foot-tall flames, Creacey and his colleagues sprayed them with aqueous film-forming foam, or A.F.F.F. 3M manufactured it from several forever chemicals, including PFOS.

Creacey remembers that A.F.F.F. felt slick and sudsy, almost like soap, and dried out the skin on his hands until it cracked. To celebrate his last day on a military base in Germany, his friends dumped a ceremonial bucket on him. Only later, after working with firefighting foam at an airport in Monterey, California, did he start to wonder if a string of ailments—cysts on his liver, a nodule near his thyroid—were connected to the foam. He had high cholesterol, which diet and exercise were unable to change. Then he was diagnosed with thyroid cancer. "It makes me feel like I was a lab rat, like we were all disposable," Creacey told me. "I've lost faith in human beings."

It may be tempting to think of Creacey and his peers as unwitting research subjects; indeed, recent studies show that PFOS is associated with an increased risk of thyroid cancer and, in Air Force servicemen, an elevated risk of testicular cancer. But it is probably more accurate to say that we are all part of the experiment. Average levels of PFOS are falling, but nearly all people have at least one forever chemical in their blood, according to the Centers for Disease Control and Prevention. "When you have a contaminated site, you can clean it up," Elsie Sunderland, an environmental chemist at Harvard University, told me. "When you ubiquitously introduce a toxicant at a global scale, so that it's detectable in everyone . . . we're reducing public health on an incredibly large scale." Once everyone's blood is contaminated, there is no control group with which to compare, making it difficult to establish responsibility.

New health effects continue to be discovered. Researchers have found that exposure to PFAS during pregnancy can lead to developmental delays in children. Numerous recent studies have linked the chemicals to diabetes and obesity. This year, a study discovered thirteen forever chemicals, including PFOS, in weeks-old fetuses from terminated pregnancies, and linked the chemicals to biomarkers

associated with liver problems. A team of N.Y.U. researchers estimated, in 2018, that the costs of just two forever chemicals, PFOA and PFOS—in terms of disease burden, disability, and health-care expenses—amounted to as much as sixty-two billion dollars in a single year. This exceeds the current market value of 3M.

Philippe Grandjean, a physician who helped discover that PFAS harm the immune system, believes that anyone exposed to these chemicals—essentially everyone—may have an elevated risk of cancer. Our immune systems often find and kill abnormal cells before they turn into tumors. "PFAS interfere with the immune system, and likely also this critical function," he told me. Grandjean, who served as an expert witness in the Minnesota A.G.'s case, has studied many environmental contaminants, including mercury. The impact of PFAS was so much more extreme, he said, that one of his colleagues initially thought it was the result of nuclear radiation.

In April, the E.P.A. took two historic steps to reduce exposure to PFAS. It said that PFOS and PFOA are "likely to cause cancer" and that no level of either chemical is considered safe; it deemed them hazardous substances under the Superfund law, increasing the government's power to force polluters to clean them up. The agency also set limits for six PFAS in drinking water. In a few years, when the E.P.A. begins enforcing the new regulations, local utilities will be required to test their water and remove any amount of PFOS or PFOA which exceeds four parts per trillion—the equivalent of one drop dissolved in several Olympic swimming pools. 3M has produced enough PFOS and chemicals that degrade into PFOS to exceed this level in all of the freshwater on earth. Meanwhile, many other PFAS continue to be used, and companies are still developing new ones. Thousands of the compounds have been produced; the Department of Defense still depends on many for use in explosives, semiconductors, cleaning fluids, and batteries. PFAS can be found in nonstick cookware, guitar strings, dental floss,

makeup, hand sanitizer, brake fluid, ski wax, fishing lines, and countless other products.

In a statement, a 3M spokesman told me that the company "is proactively managing PFAS," and that 3M's approach to the chemicals has evolved along with "the science and technology of PFAS, societal and regulatory expectations, and our expectations of ourselves." He directed me to a fact sheet about their continued importance in society. "These substances are critical to multiple industries—including the cars we drive, planes we fly, computers and smart phones we use to stay connected, and more," the fact sheet read.

Recently, 3M settled the lawsuit filed by cities and towns with polluted water. It will pay up to twelve and a half billion dollars to cover the costs of filtering out PFAS, depending on how many water systems need the chemicals removed. The settlement, however, doesn't approach the scale of the problem. At least forty-five per cent of U.S. tap water is estimated to contain one or more forever chemicals, and one drinking-water expert told me that the cost of removing them all would likely reach a hundred billion dollars.

In 2022, 3M said that it would stop making PFAS, and would "work to discontinue the use of PFAS across its product portfolio," by the end of 2025—a pledge that it called "another example of how we are positioning 3M for continued sustainable growth." But it acknowledged that more than sixteen thousand of its products still contained PFAS. Direct sales of the chemicals were generating $1.3 billion annually. 3M's regulatory filings also allow for the possibility that a full phaseout won't happen—for example, if 3M fails to find substitutes. "We are continuing to make progress on our announcement to exit PFAS manufacturing," 3M's spokesperson told me. The company and its scientists have not admitted wrongdoing or faced criminal liability for producing forever chemicals or for concealing their harms.

Hansen often wonders what her father would say about 3M if he were still alive. A few years ago, he began to show signs of dementia, which worsened during the COVID-19 pandemic. Every time Hansen explained to him that a novel coronavirus was sickening people around the world, he asked how he might contribute—forgetting that the N95 mask he helped to create was already protecting millions of people from infection. When he died, in January, 2021, Hansen noticed some Coban wrap on his arm. It was shielding his delicate skin from tears, just as he had designed it to. "He invented that," Hansen told the hospice nurse, who smiled politely.

After she left 3M, Hansen began volunteering at a local nature preserve, where she works to clear paths and protect native plants. Last August, she took me there, and we walked to a creek where she often spends time. The water is home to three species of trout, she told me. It is also polluted by forever chemicals that 3M once dumped upstream.

For most of our hike, a thick wall of flowers—purple joe-pye weed and goldenrod—made it impossible to see the creek bank. Then we came to a wooden bench. I climbed on top of it and looked down on the creek. As I listened to the gurgling of water and the buzzing of insects, I thought I understood why Hansen liked to come here. It was too late to save the creek from pollution; 3M's chemicals could be there for thousands of years to come. Hansen just wanted to appreciate what was left, and to leave the place a little better than she'd found it. ♦

ProPublica is a nonprofit newsroom that investigates abuses of power. Sign up to get stories like this one as soon as they are published.

Published in the print edition of the May 27, 2024, issue, with the headline "You Make Me Sick."

New Yorker Favorites

- First she scandalized Washington. Then she became a princess.
- What exactly happened between Neanderthals and humans?
- The unravelling of an expert on serial killers.
- When you eat a dried fig, you're probably chewing wasp mummies, too.
- The meanings of the Muslim head scarf.
- The slippery scams of the olive-oil industry.
- Critics on the classics: our 1991 review of "Thelma & Louise."

Sign up for our daily newsletter to receive the best stories from *The New Yorker*.

READ MORE

SCIENCE

Searching for 'Forever Chemicals' From an Endless Landfill Fire

Alabama residents are considering blood or urine tests to see if "forever chemicals" have resulted from a nearby landfill fire that has burned since 2022.

By Lee Hedgepeth, WIRED

ANNALS OF INQUIRY

Why We're Turning Psychiatric Labels Into Identities

So you're on the spectrum, or you've got borderline personality disorder, or you're a sociopath: once you're sure that's who you are, you've got a personal stake in a very creaky diagnostic system.

By Manvir Singh

SCIENCE

Woman Who Received Pig Kidney Transplant Has It Removed

Surgeons at NYU took out the pig kidney because it wasn't getting enough blood flow.

By Emily Mullin, WIRED

ANNALS OF MEDICINE

How ECMO Is Redefining Death

A medical technology can keep people alive when they otherwise would have died. Where will it lead?

By Clayton Dalton

NEWS

Ralph Baric, Whose Virology Techniques Were Used in Wuhan, Testified That Lab Leak Was Possible

The UNC coronavirologist who has collaborated on gain-of-function research with the Wuhan Institute of Virology's Shi Zhengli, told congressional investigators that he has long worried about biosafety protocols inside China. Though he thinks it's far more likely COVID-19 originated in nature, he said of a possible laboratory escape, "You can't rule that out."

By Katherine Eban, Vanity Fair

ANNALS OF A WARMING PLANET

What Is the Opposite of Oil Drilling?

A growing industry aims to remove carbon from the atmosphere—but it's still in its infancy, and greenhouse-gas emissions remain dangerously high.

By Michelle Nijhuis

POLITICS

RFK Jr. Says His Brain Was Partially Eaten by a Worm That Crawled Inside and Died: Everything You Need to Know

For one thing, his campaign says it won't affect his ability to serve as president.

By Bess Levin, Vanity Fair

COMMENT

Should We Be Worried About Bird Flu?

According to the C.D.C., the risk to public health remains low. But the country's initial approach has had an unsettling resonance with the first months of COVID.

By Dhruv Khullar