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WHEN TOXIC HERITAGE IS FOREVER: CONFRONTING PFAS CONTAMINATION AND TOXICITY AS LIVED EXPERIENCE

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Consumer capitalism ushered in a world of pervasive contamination, leaving a legacy of harm and a future of uncertainty. Few “toxic events” better encapsulate this than *per-* and *poly-fluoroalkyl substances*, or PFAS, a broad category of synthetic chemicals that includes several thousand substances (Renfrew and Pearson 2021). They are used to coat things or make materials that repel water or oil. Such properties have innumerable uses, ranging from clothing and furniture to nonstick cookware, food packaging, and cosmetics. PFAS came into widespread use in the 1950s before significant environmental regulation existed in the United States and have evaded meaningful oversight ever since (Richter, Corder, and Brown 2021). By the 1970s, the chemicals were turning up in drinking water, fish, and people’s bodies, but it wasn’t until the 2000s that PFAS became an emerging contaminant of scientific and regulatory concern. Their commercially desirable characteristics also make them a pernicious threat to public health. Some bioaccumulate and move easily with surface and groundwater, through air emissions, or with weather systems. And they resist degrading, some never naturally breaking down, earning the nickname “forever chemicals.”

We all embody the legacy and uncertain future of forever chemicals. Biomonitoring studies by the Centers for Disease Control and Prevention have found PFAS in the blood of almost everyone sampled, suggesting ubiquitous human exposure (CDC 2017). They’re also toxic, with extremely low levels associated with a wide range of health effects, including testicular and kidney cancer, ulcerative colitis, thyroid disease, pregnancy-induced hypertension, hypercholesterolemia, decreased vaccine response, and developmental problems (ATSDR 2020). In 2016, the Environmental Protection Agency issued a health advisory for two PFAS substances, *perfluorooctane sulfonate* (PFOS) and *perfluorooctanoic acid* (PFOA), recommending a drinking water limit of 70 parts per trillion. Then in 2022, it dramatically lowered its

advisory levels to 0.02 ppt for PFOS and 0.004 ppt for PFOA. At those levels, more than 2,000 communities, serving 43 million people, drink contaminated water (EWG 2022).

Knowledge of PFAS toxicity was secluded for decades within the companies that produce the chemicals (Bilott 2019; Richter, Corder, and Brown 2018). As a result, PFAS contamination simmered quietly, a slow-motion toxic disaster enabled by flawed regulatory structures and chemical industries that prioritize corporate profit. Today, its frequent discovery forces many communities to confront the hidden threats of once proud industrial pasts, revalued as toxic heritage. To illustrate, we trace three histories of contamination related to PFOS, one of the first PFAS substances commercialized on a mass scale. PFOS was originally in Scotchgard, a fabric coating made by the 3M company, used on iconic brands such as Hush Puppies shoes. PFOS was also a crucial component in the development of aqueous film-forming foams (AFFF) to suppress oil fires. Each of these products, with interconnected origins and histories, reveals how the discovery of PFAS contamination forces a reckoning with and reinterpretation of the past. It also prompts a new orientation towards the future, with toxic heritage signifying a “future-making” (Harrison 2022, 32) or “emergent presence” (Bangstad and Pétursdóttir 2022, 21) that informs the lived experience of PFAS toxicity, characterized by uncertain health impacts and ongoing struggles to achieve long-term solutions to a forever problem (Wollentz et al. 2020).

Wildest Hellcat

The toxic heritage of PFOS begins with an accident. After acquiring a key patent in 1948, 3M started working on commercial applications for the first PFAS, known as fluorocarbon chemicals or fluorochemicals. “Almost every day we turned out a new molecule which had never been on the face of the earth before,” recalls J. Donald LaZerte, a 3M chemist who started in 1949 (LaZerte 1989, 25). Management, however, worried about the prospects of fluorochemical research. Fluorocarbons were known, as one journalist wrote, as the “chemical daughters of the wildest hellcat of elements, fluorine, a yellow-green gas that will burn sand, glass, steel wool, asbestos, concrete or even water, and is extremely dangerous to touch or inhale” (Manchester 1959, 120). When tamed, however, the hellcat opened new possibilities. While the violence of fluorine “is born of a desperate yen to combine chemically with everything in sight,” a stable carbon-fluorine bond is considered one of the strongest known in the field of chemistry (Manchester 1959, 120).

In 1950, 3M struck a deal to produce PFOA for DuPont, which DuPont then used to manufacture Teflon, a material that had emerged from the World War II Manhattan Project, central to the numerous components, valves, and pumps needed to enrich uranium. Slippery, durable, heat-resistant Teflon coatings were revolutionizing other products, including cookware. Touted as a miracle substance, some imagined fantastic applications, from “100,000-mile tires,” “greaseless bearings,” and “rustproof steel” to “artificial arteries” (Manchester 1959, 117). But 3M

was struggling to commercialize fluorochemical products on its own, until an unexpected breakthrough. Scientists working on a military contract to develop jet fuel hoses spilled an experimental fluorochemical on a canvas shoe and couldn't remove the substance. "A fluorochemical surface is not wet by oil or water," a chemist reported in 1952. The compound surrounded each individual fiber, resulting in a protective barrier. "A textile not wet by oil or water is a highly desirable commodity," explained the report, as recounted by LaZerte (1989, 25). "Therefore, we're in the money!"

To commercialize this discovery, which utilized PFOS, 3M needed to create a market for it (LaZerte 1989, 26). Around 1956, they promoted it to textile manufacturers as Scotchgard, targeting clothing, footwear, furniture, and luggage. As uptake of Scotchgard grew within product manufacturing, 3M worked with retail stores to generate consumer demand, placing hang tags on products with Scotchgard and coordinating advertising. The challenge was in marketing an invisible product, "one that the end-user had to accept on faith alone. Or at least until a cup of coffee was spilled on the sofa" (LaZerte 1989, 26). To help visualize Scotchgard, 3M advertising blended notions of tradition and modernity. A logo featured a castle tower, conveying protection, and a tartan layout, the plaid textile design evoking Scottish tradition. The Scotchgard logo accompanied images of pre-treated products and families engaged in the mundane activities of a modern, consumer lifestyle, such as a dinner party or a child's birthday. "Look for the name 'Scotchgard' Stain Repeller on clothes you buy, on furniture, furnishings, even tablecloths," reads one advertisement. "Take your share of a new kind of carefree living" (*Life Magazine*, September 5, 1960).

Scotchgard normalized chemically treated fabrics and unleashed a large-scale human experiment. As early as the 1960s, 3M was collecting internal data from lab studies on the toxicity of fluorocarbons, with indications that PFOS accumulated in the blood of rats (Hayes 2019). Then in 1975, a bombshell landed on LaZerte's desk, who by then directed 3M's commercial chemical division. An internal memo reported on a disturbing call from William Guy, a University of Florida researcher. Guy and his colleague Donald Tayes discovered fluorocarbons in human blood serum (Bilott 2019, 75–76; Lerner 2018b). They contacted 3M and speculated about the source, including products such as Teflon and Scotchgard. Internally, 3M officials expressed alarm, but then adopted an outward posture of naivete. "We plead ignorance," according to the memo author, "a position of scientific curiosity," working with Guy and Tayes in a spirit of cooperation but without leading them to dig too deeply (Crawford 1975).

3M accelerated its studies of fluorocarbon toxicity, documenting accumulation in the blood of its workers in 1976. In 1978, 3M officials speculated that PFOS "should be regarded as toxic," but also asserted that "no substantial risk exists," concluding they had no obligation to report their findings (Prokop 1978; see also Bilott 2019, 172; Lerner 2018b). Some 3M scientists called for urgent health studies (Case 1979), raising concerns about immunosuppressive effects in 1983, and associating worker

exposure with elevated cancer rates in 1989 (Lerner 2018b; 2020). Inside 3M, health studies of Scotchgard increased in the 1990s, but it would be another decade before action was taken to reduce human exposure (Lerner 2018b).

In 1998, 3M finally divulged its studies to the EPA (Faber 2020). Still frustrated with its lack of urgency, Richard Purdy, a 3M environmental scientist, criticized the company's handling of PFOS in a resignation letter, describing it as "the most insidious pollutant since PCB" (Purdy 1999). Then in 2000, under EPA pressure, 3M surprisingly announced a market phaseout of Scotchgard (Barboza 2000). Three years later, however, 3M reformulated the ingredients, replacing PFOS with an alternative, *perfluorobutane sulfonic acid* (PFBS). In 2006, the EPA negotiated a voluntary phaseout of PFOA and PFOS, completed in 2015. But efforts to regulate the chemicals continued into the 2020s, and management of widespread contamination will continue indefinitely.

"Today," boasted LaZerte in 1989, "our 'hellcat' can be found on everything ... You can also capture this 'hellcat' in aerosol cans in your supermarket for do-it-yourself applications" (LaZerte 1989, 27). Indeed, the PFAS hellcat is everywhere. Even in the shadow of its corporate headquarters in Minnesota, 3M has contaminated the drinking water of hundreds of thousands of people. From the 1950s to the 1970s, it dumped waste from its factory in Cottage Grove at four regional dump sites. Minnesota sued 3M in 2010 and sought \$5 billion for damaging the state's natural resources with permanent groundwater contamination stretching some 150 square miles. Just before the trial in 2018, 3M settled for \$850 million, and efforts to secure long-term drinking water solutions continue.

Lost Soles

Beyond the birthplace of PFOS, contamination follows the routes of industrial development and along the commodity chains of modern consumer life. Many manufacturers incorporated Scotchgard into their production processes, but the story of Hush Puppies shoes aptly captures how the discovery of PFAS contamination involves revaluing a once proud industrial heritage as newly toxic. A leather suede shoe brand launched in 1958 out of Rockford, Michigan, Hush Puppies utilized Scotchgard, and went on to help define the counterculture trends of the 1960s, its branding as "casual" and "relaxed" synching with 3M's "carefree living" theme.

Hush Puppies fueled the growth of Wolverine Worldwide, initially founded in Rockford in 1908. Much of the original factory, built along the Rogue River, was demolished in 2010, but Wolverine's corporate headquarters remains. Now a city of 6,000 people, Rockford's economic well-being once hinged on the fortunes of Wolverine, its presence shaping daily life. Raw pigskins would arrive by rail for processing into suede, and a disagreeable odor, like chemically infused, rancid bacon, wafted over the city. It was variously described as "the Rockford stink" or "the smell of money" (Gardner 2019). Today, part of the original factory has been repurposed into a shopping store, allowing consumers to nostalgically experience

industrial heritage as they buy shoes from a now multinational corporation. For some residents, however, Rockford's postindustrial landscape has brought them illness and trauma (Trepal and Hurstad 2019, 235).

Before outsourcing manufacturing, Wolverine produced Hush Puppies in Rockford, but also tons of waste. Its wastewater discharged into the Rogue River, while truck drivers dumped animal skin remnants, leather debris, sludge laced with Scotchgard, and metal drums on land outside of town (Ellison 2019). Sludge was even spread on local farm fields, presumably intended as fertilizer (Ellison 2017d). Into the 2010s, twisted strips of leather littered the banks of the Rogue River. Entangled with plants and tree roots, the leather scraps snaked out of the ground like Medusa's hair and amassed on cattail-covered mudflats, an area dubbed the "Island of Lost Soles" (Ellison 2017a).

Contamination incubated for decades. 3M warned Wolverine officials about the hazards of Scotchgard in the late 1990s, but Wolverine did nothing (Ellison 2017c). Other signs went overlooked, regarded as curious features of a postindustrial landscape, even as housing development expanded around the small city. Residents encountered leather strips along the riverbank, or in even their yards. Hiking in the woods, one might come across a rusted barrel poking out of a hillside, or a shoe sole imprinted with the Hush Puppies logo. Such artifacts formed the unremarkable legacy of a company town, like the previous foul odor that reminded of a steady paycheck. Residents lacked a framework for perceiving the relics as anything else.

When the shoe factory was slated for demolition in 2010, some residents questioned the environmental impact of the operation. Wolverine assured the community there was "no known contamination on the property," but some residents organized as the Concerned Citizens for Responsible Remediation (CCRR) and petitioned for an EPA assessment, which found numerous hazardous substances (Ellison 2019). Wolverine, however, with the support of Rockford city officials, escaped listing the site on the federal Superfund list, with the city manager asserting that "there are no conditions at the property that present a health threat to the public" (Ellison 2019).

In 2011, a scientist for what was then the Michigan Department of Environmental Quality (DEQ) sampled for PFAS contamination at the former Wurtsmith Airforce Base in Oscoda (Ellison 2018b). His calls for a wider-scale sampling of drinking water went ignored but prompted the CCRR to start looking for signs of PFAS pollution from Scotchgard. The group petitioned to test fish from the Rogue River, with results showing elevated PFAS levels near the former tannery (Ellison 2017a). Nationwide EPA monitoring of unregulated pollutants in 2013 found PFAS in the municipal drinking water of a nearby township, and the contamination was traced to a landfill previously used by Wolverine. By 2016, the EPA had issued its first drinking water advisory for PFOS and PFOA, and Michigan subsequently issued its own advisory in Oscoda. With awareness of PFAS growing, the CCRR collected evidence of historic Scotchgard use by Wolverine and spoke to retired truck drivers to identify former dump sites. In early 2017, they presented

their findings to the DEQ, showing decades of Scotchgard use and waste disposal at forgotten dump sites, which prompted testing that occurred later in the year, triggering the discovery of widespread PFAS contamination (Ellison 2019).

Sandy Wynn-Stelt had lived across from Wolverine's House Street Dump site for 24 years when she learned that her well was highly contaminated. Her husband died the year before at age 61 from liver cancer. She herself suffers from thyroid disorders. The discovery of contamination was devastating. The recent loss of her husband was compounded by a shattering of her assumptions about the place she lives and the surrounding environment. "You lose your husband and it's the worst thing on Earth," she said in 2017. "But you slowly get back. You slowly kind of come back to life ... I remember in June this year thinking 'I feel like I'm getting my joy back.' And in July, I get these government people walking up my driveway and saying, 'we think you've got poisoned groundwater.' And it's just brought it all back." Her home, once a grounding source of order in her life, became a threat to her health and economic security. "I have a property now that is sitting next to a toxic waste dump, so my entire life savings is probably down the drain," she said (Ellison 2017b).

Her neighbor's water wasn't tested until a few months later. By then, Seth McNaughton's son was almost two, an age when every day of exposure has a compounding impact. "In his short life," he said, "he would have had so much less water" contaminated with PFAS, if they had known earlier. "He would have a lot less in his blood" (Ellison 2018a). Like other exposure experiences, they now contend with immense stress and uncertainty about the future (Edelstein 2004). Health outcomes may also take years or decades to register. "The biggest thing," said McNaughton (MLive 2018), "is like, the fear and worry of what might happen. You know, that's really where we're at now, just dealing with that and just moving on with our life. We're trying not to worry about it too much because then it will just make it worse. So, you just live like it's not happening."

Black Plumes

Beyond Scotchgard, the 1960s saw another turning point for 3M's fluorocarbon research, which would become a major source of PFAS contamination worldwide. In 1966, the U.S. Navy patented a process for using foams to suppress oil fires, relying on an AFFF product developed by 3M with PFOS as a key component (ITRC 2021, 52). After a fire on the USS Forrestal in 1967 killed 134 sailors, the Navy began requiring all its ships to carry 3M's AFFF (NSRDC 1978). By the 1970s, the Department of Defense required AFFF at military installations (Lerner 2018a), and it was soon adopted at civilian airports and other industrial facilities. While 3M no longer produces AFFF, it supplied the military until around 2001. When 3M phased out PFOS and left the AFFF market, other companies raced to fill the lucrative void with alternative PFAS-containing foams (Bond 2021; ITRC 2021, 52–53; Lerner 2018a).

Over the decades, AFFF has been used in response to fires, but also during routine testing or training, indiscriminately released into the environment. Today, numerous communities that host airports, military installations, or industries wrestle with the toxic legacy of AFFF. One such community, Peshtigo, Wisconsin, is a rural township that surrounds Marinette, a small city on the mouth of Menominee River as it empties into Lake Michigan. Paper mills, a metal casting foundry, and a shipbuilding plant crowd the industrial riverfront, joined by Johnson Controls International (JCI) and ChemDesign, sibling companies that sell AFFF firefighting foams, a local industry that began with the Ansul chemical company. Founded in 1915 to produce refrigerants, Ansul expanded into fire extinguishers and fire suppression systems in 1939 and soon established a firefighting school. By the 1960s, Ansul expanded into producing specialized herbicides and pesticides, including Agent Orange during the Vietnam War. Ansul began testing 3M's foam concentrates around 1962 at its outdoor training grounds, today called the Fire Technology Training Center, located on the boundary with Peshtigo. It distributed 3M's AFFF and developed its own product around 1973 (Mator 2018). Ansul was acquired by Tyco International in 1990 and renamed Tyco Fire Products, and Tyco was acquired by JCI in 2016.

The Fire Technology Center is surrounded by acres of wooded land. While it feels isolated, just beyond the site are the high school, shopping centers, neighborhoods, a hospital, and the town of Peshtigo. Every summer, people from around the country visit the center to work with AFFF, extinguishing live fires at the outdoor training ground. "For forty years, there'd be black plumes comin' up every day" during the summer, recalled John Kowalski in an interview in December 2018. Over the decades, foams seeped into the ground or were flushed into the sewer system. The city of Marinette draws water from Lake Michigan, considered safe. Residents in Peshtigo, however, including John and his wife Ruth, rely on groundwater, with some wells contaminated by PFAS. Tyco has accepted responsibility for an area near its property but denies blame for wells contaminated elsewhere. In addition, biosolids from Marinette's wastewater treatment plant, tainted with PFAS, were spread on farm fields for years, distributing contamination regionally. The Department of Natural Resources has spent years trying to determine the extent of contamination and hold Tyco accountable, an ongoing effort.

Residents like John and Ruth were informed about PFAS in December of 2017, four years after Tyco first detected groundwater contamination. The discovery was disorienting. Ruth had recently been treated for thyroid disease, and John for prostate cancer. Memories of their children's inexplicable health issues while growing up came flooding back, and then they pondered their grandchildren's illnesses and developmental challenges. Ruth's mother had had thyroid cancer, and now her granddaughter has thyroid disease. "I'm just shocked by all the cancer around here," John explained.

Like in Rockford, MI, exposure to PFAS emerged quickly as a "perceptual framework" for reinterpreting daily life in relation to a newly conceived toxic

heritage (Edelstein 2004, 75). Knowledge of exposure, however, does not bring clarity, but heightened stress and uncertainty about unknown consequences. “One house can be contaminated, the next one a non-detect,” said John. Facing complex histories of industrial pollution and potential exposures, uncertainty fuels a sense of insecurity. Their home, which belonged to John’s parents and has been in their family for decades, was once a place of refuge, several acres of land with apple trees, gardens, and a pond. Now they fear drinking or cooking with tap water. That sense of loss extends further, with PFAS contamination transforming how some residents relate to places they have long known. “For years,” explained one woman in a May 2019 social media post, “the plumes I watched rise above the trees behind my grandparents’ woods brought me a sense of pride. Pride because all of the fire extinguishers my parochial grade school in Chicagoo used were from Ansul . . . Now, it is with shame that I remember how I told all my friends that I knew where that was made.”

This new understanding of local toxic heritage may reveal multiple, interacting potential exposures, with past industrial activities, previously forgotten or ignored, now representing a threat. Ruth and John wonder if the paper mills made people sick and they speculate about Ansul’s decades of producing chemical herbicides. The company was still working to clean up arsenic contamination along the Menominee River into the 2010s. “They probably tested Agent Orange on our beaches,” John sneered. They recall how their children would play in the drainage ditches and cricks that run past the Fire Technology Center, and swim in a small pond located nearby. They would notice foam flowing with the water through the ditches to Lake Michigan or washing up on a local beach. “I never really thought about where it was coming from,” says John, so it went ignored. Now, however, the surrounding environment, once a benign backdrop to rural life, is perceived as malevolent (Edelstein 2004, 84). “I wouldn’t eat an apple off that tree,” remarked Ruth during a December 2018 interview, pointing to the backyard. Contaminated ditches currently have warning signs posted, and residents document foam sightings.

Others are similarly reinterpreting their memories of Ansul as they perceive the rural postindustrial landscape of Peshtigo and Marinette through the new experience of PFAS toxicity. As Annie Boyle Davis recounted, “When we were little kids, we would say to Mom, ‘Mommy, it smells like Ansul.’ It was just this horrible smell and we just called it ‘Ansul’. It was probably the way the wind was blowing and what they were making. One day we went to school, I want to say it was 1970, and all the foliage around the school—the trees, the leaves, the grass—were dead” (Bence 2019). Another area resident recalls the same period—a summer when the trees in their yard had no leaves. At a public listening session hosted by the Wisconsin DNR in December 2019, she said “we had continuous bloody noses, sore throats, blood coming out of ears. The stench was so bad when the wind blew across the river that we had to keep our doors closed. We didn’t know what was going on. We were told not to make any waves, because the chemical company could move away and take all the jobs with them.” Now, she says, “I believe it was due to the chemicals we were breathing. The trees didn’t lie.”

Conclusion

Over the twentieth century, modern life became infused with forever chemicals. PFAS were meant to make us into carefree consumers free of messiness and worry, and in the case of AFFF, free from potentially deadly hazards. What we find instead is a simultaneously latent and emerging toxic heritage. The stunning range of uses for PFAS have set the stage for the continuous discovery of unanticipated contamination sources. Confronting PFAS contamination entails reconsidering personal and collective memories that bind people to the places they live and questioning the industries on which their communities were built. Plumes of smoke in Marinette and Peshtigo, or strips of old leather in Rockford, once taken for granted, have come to signal a new hazard.

As communities discover PFAS contamination, people are forced to reckon not only with the past but also with their own embodiment of toxicity. Industrial heritage, once a source of local pride and well-being, is newly experienced as a toxic heritage. This is not merely a question of what happened long ago, however, a postindustrial phenomenon where deindustrialized, neglected, and often racialized urban landscapes unearth toxic timebombs from a bygone era (Mah 2012). With PFAS, the past colonizes a forever unfolding present with chemicals that don't break down, are pervasive in the environment and continue to be widely used. The revaluating of industrial history as toxic heritage informs the perceptual frameworks through which PFAS contamination becomes intelligible, through which people make sense of toxicity as lived experience, and, ultimately, through which some challenge the systems that created this crisis.

To the extent that some victims of contamination fight for accountability, this is also a conflict over the future, over the uncertain consequences for those exposed, and over the management of contamination that is difficult to contain and will persist indefinitely. As one resident in the Peshtigo area said in an April 2021 interview, "they've poisoned our water with a forever chemical, so we want a forever solution."

Bibliography

- ATSDR. 2020. "Potential Health Effects of PFAS Chemicals." Agency for Toxic Substances and Disease Registry, U.S. Department of Health and Human Services, June 24. <https://www.atsdr.cdc.gov/pfas/health-effects/index.html>
- Bangstad, Torgeir Rinke and Þóra Pétursdóttir. 2022. "An ecological approach to heritage." In *Heritage Ecologies*, edited by Torgeir Rinke Bangstad and Þóra Pétursdóttir, 3–27. London: Routledge.
- Barboza, David. 2000. "E.P.A. Says It Pressed 3M for Action on Scotchgard Chemical." *The New York Times*, May 19. <https://www.nytimes.com/2000/05/19/business/epa-says-it-pressed-3m-for-action-on-scotchgard-chemical.html>
- Bence, Susan. 2019. "Marinette Residents Want to Get PFAS Chemicals Under Control." *WUWM* 89.7, August 29. <https://www.wuwm.com/post/marinette-residents-want-get-pfas-chemicals-under-control>

- Bilott, Robert. 2019. *Exposure: Poisoned Water, Corporate Greed, and One Lawyer's Twenty-Year Battle against DuPont*. New York: Atria Books.
- Bond, David. 2021. "The US Military Is Poisoning Communities across the US with Toxic Chemicals." *The Guardian*, March 25. <https://www.theguardian.com/commentisfree/2021/mar/25/us-military-toxic-chemicals-us-states>
- Case, M. T. 1979. "Fluorochemical Chronic Toxicity, 3M Interoffice Correspondence." Exhibit 1212, State of MN v. 3M Co., Court File No. 27-CV-10-28862. <https://www.documentcloud.org/documents/4609339-1979-Paramont-to-Do-Carcinogenicity-Testing.html>
- CDC. 2017. "Per- and Polyfluorinated Substances (PFAS) Factsheet." Center for Disease Control and Prevention. https://www.cdc.gov/biomonitoring/PFAS_FactSheet.html
- Crawford, G. H. 1975. "Confidential Record of a Telephone Conversation, 3M Interoffice Correspondence, Subject: Fluorocarbons in Human Blood Plasma." Exhibit 1118, State of MN v. 3M Co., Court File No. 27-CV-10-28862. <https://www.ag.state.mn.us/Office/Cases/3M/docs/PTX/PTX1118.pdf>
- Edelstein, Michael R. 2004. *Contaminated Communities: Coping with Residential Toxic Exposure*. Boulder, CO: Westview Press.
- Ellison, Garret. 2017a. "Scotchgard Chemical Ails Fish Where Tannery Scraps Litter River." *Mlive.com*, August 23. https://www.mlive.com/news/2017/08/wolverine_tannery_pfos.html
- Ellison, Garret. 2017b. "Cancer, Thyroid Problems Plague Wolverine Dump Neighbors." *Mlive.Com*, October 1. https://www.mlive.com/news/grand-rapids/2017/10/house_street_dump_neighbors.html
- Ellison, Garret. 2017c. "3M Document Shows Wolverine Knew about PFAS in 1999." *Mlive.com*, November 4. https://www.mlive.com/news/grand-rapids/2017/11/3m_scotchgard_wolverine_pfas.html
- Ellison, Garret. 2017d. "More than 100 Homes in New PFAS Testing Area near Rockford." *Mlive.com*, November 14. https://www.mlive.com/news/grand-rapids/2017/11/sludge_farm_wellington_ridge.html
- Ellison, Garret. 2018a. "DEQ Ignored Crucial Warning on Wolverine Dump Plume." *Mlive.com*, March 12, 2018. https://www.mlive.com/news/grand-rapids/2018/03/pfas_deq_odonnell_www.html
- Ellison, Garret. 2018b. "Major Warning about Michigan PFAS Crisis Came 6 Years Ago." *Mlive.com*, July 10. https://www.mlive.com/news/2018/07/meq_pfas_delaney_2012_report.html
- Ellison, Garret. 2019. "How Citizen Sleuths Cracked the Wolverine Tannery Pollution Case." *Mlive.com*, June 12. <https://www.mlive.com/news/2019/06/how-citizen-sleuths-cracked-the-wolverine-tannery-pollution-case.html>
- EWG. 2022. "More than 2,000 Communities Have Drinking Water with 'Forever Chemicals' above New EPA Levels." *Environmental Working Group*, June 15. <https://www.ewg.org/news-insights/news-release/2022/06/more-2000-communities-have-drinking-water-forever-chemicals>
- Faber, Scott. 2020. "For 20-plus Years, EPA Has Failed to Regulate 'Forever Chemicals.'" *Environmental Working Group*, January. <https://www.ewg.org/research/20-plus-years-epa-has-failed-regulate-forever-chemicals>
- Gardner, Paula. 2019. "When the Biggest Company in Town Poisons the Water." *Mlive*, June 11. <https://www.mlive.com/news/2019/06/when-the-biggest-company-in-town-poisons-the-water.html>

- Hayes, Jared. 2019. "For Decades, Polluters Knew PFAS Chemicals Were Dangerous but Hid Risks from Public." *Environmental Working Group*, August 29. <https://www.ewg.org/research/decades-polluters-knew-pfas-chemicals-were-dangerous-hid-risks-public>
- Harrison, Rodney. 2022. "Legacies: Rethinking the futures of heritage and waste in the Anthropocene." In *Heritage Ecologies*, edited by Torgeir Rinke Bangstad and Þóra Pétursdóttir, 31–48. London: Routledge.
- ITRC. 2021. "Per- and Polyfluoroalkyl Substances Technical and Regulatory Guidance." Interstate Technology and Regulatory Council. <https://pfas-1.itrcweb.org/wp-content/uploads/2022/03/PFAS-Full-PDF-December-2021-Update.pdf>
- LaZerte, J. Donald. 1989. "3M'S Scotchgard Brand Fabric Protector." *Research Technology Management* 32 (2): 25–27.
- Lerner, Sharon. 2018a. "The U.S. Military Is Spending Millions to Replace Toxic Firefighting Foam with Toxic Firefighting Foam." *The Intercept*, February 10. <https://theintercept.com/2018/02/10/firefighting-foam-afff-pfos-pfoa-epa/>
- Lerner, Sharon. 2018b. "3M Knew About the Dangers of PFOA and PFOS Decades Ago, Internal Documents Show." *The Intercept*, July 31. <https://theintercept.com/2018/07/31/3m-pfas-minnesota-pfoa-pfos/>
- Lerner, Sharon. 2020. "The Battle for Decatur: PFAS Contamination Divides an Alabama Town." *The Intercept*, August 23. <https://theintercept.com/2020/08/23/pfas-3m-decatur-alabama/>
- Mah, Alice. 2012. *Industrial Ruination, Community and Place: Landscapes and Legacies of Urban Decline*. Toronto: University of Toronto Press.
- Manchester, Harland. 1959. "Amazing Fluorocarbons Promise Stainproof Clothing." *Popular Science*, January.
- Mator, Richard. 2018. "Tyco Fire Products, LP, Response to WDNR, January 16." BRRTS Activity No. 02-38-580695. Bureau for Remediation and Redevelopment Tracking System (BRRTS), Wisconsin Department of Natural Resources.
- MLive. 2018. *MDEQ Official Watches Video of a Father Angry over PFAS Contamination*. <https://www.youtube.com/watch?v=aD8RoZkF3SA>
- NSRDC. 1978. "Candidate Environmental Impact Statement on Discharging Firefighting System Aqueous Film Forming Foam (AFFF) into Harbor Waters During Tests of Machinery Space Fire-Fighting Foam Systems Aboard U.S. Navy Ships." Naval Ship Research and Development Center, U.S. Department of the Navy. <https://www.documentcloud.org/documents/4343203-US00006835.html>
- Prokop, R. A. 1978. "Meeting Minutes - Review of Animal Studies, 3M Interoffice Correspondence." Exhibit 1174, State of Minnesota V. 3M Co., Court File No. 27-CV-10-28862. https://static.ewg.org/reports/2019/pfa-timeline/1978_Rats-and-Monkeys-Memo.pdf?_ga=2.55161198.455752248.1651760686-1458525737.1651760686
- Purdy, Richard. 1999. "Letter from R. Purdy to 3M Re: Resignation." Exhibit 1001, State of Minnesota v. 3M Co., Court File No. 27-CV-10-28862. <https://www.ag.state.mn.us/Office/Cases/3M/docs/PTX/PTX1001.pdf>
- Renfrew, Daniel and Thomas W. Pearson. 2021. "The Social Life of the 'Forever Chemical': PFAS Pollution Legacies and Toxic Events." *Environment and Society* 12 (1): 146–163. [10.3167/ares.2021.120109](https://doi.org/10.3167/ares.2021.120109).
- Richter, Lauren, Alissa Corder, and Phil Brown. 2018. "Non-Stick Science: Sixty Years of Research and (in)Action on Flourinated Compounds." *Social Studies of Science* 48 (5): 691–714.

- Richter, Lauren, Alissa Cordner, and Phil Brown. 2021. "Producing Ignorance Through Regulatory Structure: The Case of Per- and Polyfluoroalkyl Substances (PFAS)." *Sociological Perspectives* 64 (4): 631–656. 10.1177/0731121420964827.
- Trepal, Dan and Kaeleigh Herstad. 2019. "Postindustrial Landscapes, Communities, and Heritage." *Journal of Community Archaeology and Heritage* 6(4): 235–237. doi:10.1080/20518196.2019.1670394.
- Wollentz, Gustav, Sarah May, Cornelius Holtorf, and Anders Högberg. 2020. "Toxic heritage: Uncertain and unsafe." In *Heritage Futures*, 294–312. London: University College London.