

# Surveying the Chemical Anthropocene

## Chemical Imaginaries and the Politics of Defining Toxicity

*Yogi Hale Hendlin*

■ **ABSTRACT:** Faced with the non-optional acceptance of toxic chemical artifacts, the ubiquitous interweaving of chemicals in our social fabric often exists out of sight and out of mind. Yet, for many, toxic exposures signal life-changing or life-ending events, phantom threats that fail to appear as such until they become too late to mitigate. Assessments of toxicological risk consist of what Sheila Jasanoff calls “sociotechnical imaginaries,” arbitrations between calculated costs and benefits, known risks and scientifically wrought justifications of safety. Prevalent financial conflicts of interest and the socially determined hazards posed by chemical exposure suggest that chemical safety assessments and regulations are a form of postnormal science. Focusing on the histories of risk assessments of pesticides such as DDT, atrazine, PFAS, and glyphosate, this article critically reviews Michel Serres’s notion of “appropriation by contamination.”

■ **KEYWORDS:** Anthropocene, chemical industry, chemicals, environmental justice, exposure, glyphosate, toxicity

If the Anthropocene is defined as the age in which industrialization briefly became a predominant disruptor of Earth’s geological forces, then the proliferation of chemical manufacturing and synthesis has played a central role. This article contributes to discourses on the Chemical Anthropocene<sup>1</sup> through exploring the justifications and stories or imaginaries deployed to construct legitimation and social license for continued toxic chemical manufacture and exposure harming humans, other organisms, and the environment. The concomitant downplaying of systemic asymmetries between those exposed to toxic chemicals and those benefiting financially or materially from them especially deserves interrogation. Overvaluing the benefits of chemicals in society and underappreciating the real and reported costs to life and land has become standardized, with its roots in other entwisted forms of discrimination and epistemic silencing (Pellow and Brulle 2005; Santos 2016; Sullivan and Tuana 2007).

Drawing on theories of denial(ism) permits analysis of the politics of expendability, in which groups of people and territories are made into sacrifice zones; what supposed benefits are wrought from the sacrifices made by these people and territories; and the different actors that determine this ongoing calculus, which center exclusionary practices that prevent democratic processes from allowing those most affected by pollution to decide what constitutes an acceptable level of risk (Bardon 2019; MacKendrick 2018; Markowitz and Rosner 2002; Proctor and Schiebinger 2008). Power relations shape the politics of defining toxicity. Critical frameworks in science and technology studies (STS) (Jasanoff and Kim 2015), postnormal science (Funtowicz and Ravetz 1990), public health (Lerner 2010; Valles 2018), and sociology (Latour 2018;



Serres 2010; Szasz 2007) describe both the problem of the Chemical Anthropocene as well as model successful public actions that restore environmental health to local, diverse populations. Borrowing from Sheila Jasanoff's (2015) notion of "sociotechnical imaginaries," this article discusses how dominating chemical imaginaries compartmentalize chemical elements for regulation, failing to attend to the dysergistic cocktail effects of actual chemical compound exposures and bioaccumulation.

Framing chemical imaginaries *as such* allows us to understand the will to contaminate, which seems so powerfully fatalistic in the twentieth and early twenty-first centuries. Discussing both the theory and politics of contamination leads to the uncomfortable awareness of patterns of denial, contempt for life, and the politics of expendability across an array of cases of major chemicals proven to be toxic, including flame retardants, C8, cellulose viscose (rayon), and the most applied pesticide in history, glyphosate. Despite long-standing knowledge of various chemical harms, governmental institutions and companies more often than not have deferred to industry economic imperatives over the warnings of public health experts, toxicologists, the self-reports of workers, and other canaries in the chemical plant capable of protecting the public from known dangers (Agard-Jones 2013; Guinier and Torres 2003). Scrutinizing the transparent inequalities in the social and chemical determinants of health, the undemocratic distribution of which enables these exposures, I critically evaluate the practices of acceptable collateral damage in chemical production, application, and disposal, where exposures of certain classes of people and communities to threatening levels of toxins are justified by the economic efficiency or the convenience of chemical products. Corporations and governments often share responsibility for sanctioning unjust exposures, warranting a cross-cutting analysis of the mechanisms and interests propagating chemical environmental injustices.

### **Chemical Impacts Hidden in Plain Sight**

From Rachel Carson's (1962) groundbreaking study on chemical exposure, *Silent Spring*, to Robert Bullard's (1989) *Dumping in Dixie*—one of the first books documenting environmental racism—chemicals have been recognized as a threat of sufficient magnitude to end the Holocene. Since World War II, US chemical production has increased more than 15 times (Di Renzo et al. 2015), amounting to more than 30,000 pounds of chemical produced annually per capita. It was only after 1988 that the concrete substances and harms of chemicals were replaced with a more diffuse enemy, global warming. This new framing both minimized the myriad environmental problems of extractivism and dislocated lived chemical and environmental harms from the local context to a global one, presenting a challenge so disperse as to occlude effective access points for prevention or intervention.

While being robbed of sufficient resources to protect against chemical exposures is one problem, targeted marketing of chemicals is another. For example, the \$400 billion global beauty industry engages in marketing practices that predominantly promote narrowly defined European standards of beauty. These toxic norms have led many African American, Latina and Asian American women to decide to buy and use beauty products that contain toxic chemicals such as phthalates. These disproportionate exposures are due not only to increased physical contact with such chemicals, but also to the fact that they tied into racist advertising practices. The results are grave: African American women are disproportionately likely to develop uterine leiomyomas (fibroids) linked to phthalate exposure (largely found in "beauty" products), and this is *independent of their socioeconomic status*. These women will incur up to \$34 billion in medical costs annually, which of course is in addition to the physical and mental suffering that they

experience (Zota et al. 2019). Chemical exposures and the costs of ecological destruction have nothing to do with a generalized Anthropocene. Chemical biotoxicity burdens are raced, sexed, gendered, and age-specific in their effects.

Asymmetries of chemical exposure have resulted from structural inequalities in power relations. Women, children, the elderly, African Americans, Indigenous communities, people of color, and the poor have been and continue to be disproportionately harmed by chemical exposures (Fagin and Lavelle 2002; Pellow 2007; Standing Committee on Emerging Science for Environmental Health Decisions et al. 2018). According to the *Fumes across the Fence-Line* report, Black Americans are 75 percent more likely to live in the vicinity of chemical and petrochemical industrial facilities than White Americans (NAACP and Clean Air Task Force 2017). Inequitable political recognition and resource distribution has exacerbated the difficulties for those least protected from chemical exposures to convince or force governments and manufacturers to respond to voiced claims (Braveman and Gottlieb 2014; Davies 2018; Lerner 2010).

Conversely, those benefiting the most from the technoscientific liquidity (Bauman and Don-skis 2013) of the Chemical Anthropocene have become systematically inured to the impacts of unavoidable chemical exposures. The myth of purity, and of total escape, fosters this illusion of nonporosity: to pretend that one can pollute without becoming polluted (Serres 2010). Chemical exceptionalism and asymmetrical benefits and harms comprise a scalar instance of the delayed and denied fallout of systemic, enforced injustices.<sup>2</sup>

Perhaps because of this bracketed chemical imaginary, the historical shift from toxic chemical exposures predominantly harming disadvantaged groups working directly with and around chemicals to global continuous exposures affecting all has failed to incite a proportional reaction to reassess the harms and implications of the Chemical Anthropocene. Instead of accepting the porosity of bodies, the promiscuity of substances, and the limits of chemical containment—what Stacy Alaimo (2010) calls the “trans-corporality” of toxins, which respect no social groupings or artificial national boundaries—fearful elites double down on technologies (including other chemicals) in attempts to buffer themselves from now universal exposures (Allen 2017). Whereas the only rational option is to reduce exposures overall, privileged swaths of the population have barricaded themselves against the quickly degrading commons that we all rely on (Serres 2010; Szasz 2007). This chemical exceptionalism has led to techniques of distantiation (Beck 1992), such as relocating to pristine environments, adopting not-in-my-backyard (NIMBY) ordinances disallowing local industrial manufacturing, shipping manufacturing and waste overseas, and erecting other barriers to exposure through living in a bubble of commodities to ward off omnipresent toxins. Predictably but unhelpfully, these false perceptions of safety have neutralized the otherwise pressing political issue of chemical exposures for the political class. The consequences of elites anesthetizing themselves to the threat of troublesome toxins was to offload the responsibility for political action onto those most affected—a domestic form of chemical imperialism.

Chemical imperialism denotes the process of increasing the exposure and involvement of chemicals in people’s everyday lives, and the globalization of the West’s chemical externalities constitute a version of it. Chemical products are injected into society, becoming indispensable elements of modern life. But their toxicity harms those least privileged domestically, and the aggressive export of manufacture and use of these chemicals reproduce these disparities in toxic harms abroad.

The spread of chemical manufacture into the poorest world regions has followed a colonial pattern (Garcia-Johnson 2000). While the European Union is lauded for having some of the strictest chemical regulations in the world (Vaughan 2015), earlier reports found that the United States, the United Kingdom and Europe “have compiled similar records in controlling

substances suspected of causing cancer in humans” (Brickman et al. 1985: 52), insulating themselves from carcinogenic chemicals. “Overseas” to them meant “politically out of mind”: they indulged in more exploitation and spread the industrial diseases associated with toxics exposures (Bartley 2018).

While synthetic chemistry undoubtedly has enabled many gains in water purification, sanitation, building materials, and convenience, chemical supremacy has overshadowed other traditions of taking care of human and more-than-human needs. Nontoxic pesticides, integrated pest management, and traditional co-planting strategies (such as the Central American Indigenous traditions of planting together the “three sisters” of beans, corn, and squash, each providing endogenous insecticides and scaffolding for the others) serve the same purpose as agrochemicals without the toxic side-effects (Badgley et al. 2007; Kimmerer 2015; Nabhan 2013). Yet, these naturecultural traditions for many decades were stigmatized as being anti-technology or antimodern, as a result of colonial attitudes toward their use (Hendlin 2014). This perception among farmers has only recently begun to fade.

Synthetic chemicals are simultaneously ubiquitous and hidden in our lives. From the seemingly innocuous but toxic Teflon (C8) covering nonstick pans and Gore-Tex jackets, to synthetic material clothes (vinyl chloride), to BPA-formed bottled water, having to take stock of lurking toxins imparts an unfair anxiety burden on consumers (MacKendrick 2018). As a result, awareness of the toxic chemicals accumulating in our bodies usually is relegated to the back of our minds until or unless illness strikes. Terror management theory states that we are more likely to pay attention to immediate, evolutionarily primed threats of violence, than the slow violence of often almost invisible chemical exposures (Solomon et al. 2015). Even without the active chemical industry campaigns of denialism, the future-oriented dangers of chemicals fall outside the immediacy of daily concerns. This is ironic, as chemicals pose a large (if not the largest) threat to human and planetary health.

Chemical signatures of the Anthropocene include DDT in postwar lake and sea sediment layers worldwide (Waters et al. 2016); the infusion of microplastics in virtually every substance on earth is another indelible sign (Geyer et al. 2017). Chemicals also are hidden, deliberately so, as we are assuaged of our fears from noisome scientific studies by substituting socially delegitimized chemicals for the next toxin, pretending that this time the new chemical will give us all of the features we desire without any of the harm of “regrettable substitutions” (Allen 2016; Soechtig and Seifert 2019).

Chemistry occurs everywhere; yet the unique interventions of humans to distill, extract, concentrate, and synthesize new chemicals and increase the doses of existing compounds have created new planetary harms, scaled up to the massive levels of industrial artificial chemical production and use, ever with new markets on the horizon. Many naturally occurring chemicals are dangerous to human and environmental health, yet rarely are these found in the amounts, concentrations, or pervasiveness that they exist in our anthropic, profit-motivated world. Controlling chemicals has created matter-out-of-place—colliding human bodies and the more-than-human world with the residuals of a linear factory model of production. Chemicals are elemental: buried in our air, water, soil, and affecting the temperature. There is no avoiding them.

## Understanding Chemical Imaginaries

The power of chemicals to harm various organisms is a biochemical matter, but the choice to allow or disallow a given class of chemicals, the decision to place restrictions on researching, testing, and bringing certain chemicals to market, and the subsequent quandary of what is to

be done once a given chemical has been proven to cause harm results from a constellation of clashing ideologies, interests, and power relations between various actors—including institutionally discriminated against people, chemical industry laborers, company shareholders, chemical industry executives, buyers along the product chain, and government agencies. There is no detangling this bundle of actors and interests; they exist in relation to one another. Yet, gaining insight into chemical imaginaries, and how they are constructed, provides tools for understanding shifting power structures and relations, and thus disrupts status quo “acceptable” harms and outcomes.

In the critical tradition of viewing sociomaterial conditions as imaginaries projected from the interference patterns of public struggles for power, Charles Taylor posits that “the social imaginary is that common understanding that makes possible common practices and a widely shared sense of legitimacy” (2004: 22). While Taylor emphasizes the background conditions and assumptions that go into reasons and reasoning in a similar way that Jürgen Habermas (1987) views this same phenomenon as the “lifeworld,” in her depiction of sociotechnical imaginaries Sheila Jasanoff follows Arjun Appadurai’s counter-public inflected version of imaginaries. Appadurai conceptualizes imaginaries as dueling among “disjuncture and difference” across an actively “organized field of social practices” (1990: 50), stressing that the organization of imaginaries is not some harmonious or chance happening, but rather an intentional power-infused struggle for definition and redefinition. For Jasanoff, to “treat the material apart from the social” (2015: 2) is to commit not only ethical and ontological errors, but also epistemological distortions.

Jasanoff elucidates her template for sociotechnical imaginaries as a form of “co-production.” The concept

is shorthand for the proposition that the ways in which we know and represent the world (both nature and society) are inseparable from the ways in which we choose to live in it. Knowledge and its material embodiments are at once products of social work and constitutive of forms of social life; society cannot function without knowledge any more than knowledge can exist without appropriate social supports. Scientific knowledge, in particular, is not a transcendent mirror of reality. It both embeds and is embedded in social practices, identities, norms, conventions, discourses, instruments, and institutions—in short, in all the building blocks of what we term the social. The same can be said even more forcefully of technology. (Jasanoff 2004: 2–3)

Co-production provides a critical science studies perspective to interrogate how chemicals have been so recalcitrant to scrutiny and intervention. More recently, Jasanoff has emphasized the interplay of the “normativity of the imagination with the materiality of networks” producing imaginaries “at once products of and instruments of the coproduction of science, technology, and society in modernity” (2015: 19). This framework breaks free from the locked-in power relations of other forms of analysis and attends to present agencies and the fragility of existing practices and arrangements, detailing fertile fissures in what might otherwise appear as monolithic institutions or deterministic mechanisms. Analysis of government agencies, for example, shows that far from being concordant, government divisions operate unevenly according to surges in competing ideologies and interests—from revolving-door chemical industry representatives to institutionalized environmental justice scientists and activists advocating community health (Harrison 2019).

Because chemical policy and regulation results not only from the work of active citizens, political institutions, and authorities, but is contingent on contestations between independent and interest-conflicted science (as well as major transnational corporations’ financial exigencies

and lobbying), viewing chemical policy as a product of sociotechnical imaginaries can help account for its complexity. This approach assesses the perspectives and power of differently situated actors while critically attending to their relative impact in decision-making. Without structural fatalism, and eschewing a privileged disembodied epistemic perspective, unexpected shifts in discourse around these issues can be connected with the material structures and incentives in such decisions. One example of the latter is when plaintiffs' attorneys are willing to settle class action lawsuits to secure significant compensation for their own efforts even if going to trial would have resulted in potentially more meaningful outcomes for both the victims and the scientists, as in the case of the recent Bayer glyphosate settlement (Bronstad 2020).

While the Chemical Anthropocene is continuous with the colonial project of dispossession through appropriation (Harvey 2006), it is unique in that rather than capturing land or other goods, it dispossesses through *polluting* goods, bodies, or territories, rendering them no longer functional for their original inhabitants (Merchant 1980; Szasz 2007). Chemical contamination becomes occupation *in absentia*, a mode of claiming space without needing to physically occupy it directly. Sacrificial contamination of areas and peoples under the cover of grand narrative claims is the centuries-running result of the instrumental logic of colonialism, rather than the exclusive domain of apologists for chemical pollution. And the more toxins proliferate, the farther the reach of chemical imperialism. The chief justification of chemical imperialism, that the costs there are always worth the "progress" here, only operates by ignoring and denying other contesting sociotechnical imaginaries. The everydayness of chemical exposure becomes naturalized as an inescapable part of the bargain of civilization instead of being viewed as a fixable system design flaw that leads to environmental injustices.

Chemical sacrifice zones become glossed as acceptable collateral damage according to an ideology of infinite exchangeability and deracination (Klein 2008; Lerner 2010). Such ideologies of collateral damage are wedded to millenarian notions of progress. Carolyn Merchant identifies the fatalistic argument that pollution is a necessary byproduct of progress in the birth of large-scale mining in Europe. She paraphrases Georg Agricola's (1494–1555) *De Re Metallica* (*On Metals*)—the first modern treatise on mining:

Agricola responded that most mines occurred in unproductive, gloomy areas. Where the trees were removed from more productive sites, fertile fields could be created, the profits from which would reimburse local inhabitants for their losses in timber supplies. Where the birds and animals had been destroyed by mining operations, the profits could be used to purchase "birds without number" and "edible beasts and fish elsewhere" and refurbish the area. (Merchant 1980: 38)

From medieval justifications for mining to Louisiana's Cancer Alley—the 80-mile stretch of the Mississippi River between Baton Rouge and New Orleans called by this name for its high concentration of chemical plants and the highest cancer rates in the United States (Misrach and Orff 2014)—the justification for pollution and despoilment is bought through the promise of compensation. Industrial interventions are glossed as improvements against lands or lives that thus far had not been used up as completely as they could in extracting maximum commercial value. The distantiated accounting of extractivism could be chalked up to the "normal accidents" of a "risk society" (Beck 1992; Perrow 1999), where the displacement of recompense temporally into the forever-delayed future and geographically to the enjoyment of goods by other people in other places justifies such takings.

Challenging such economic analysis requires understanding what is at stake in such socio-technical imaginings. The standard justification rationalizes the begrudgingly recognized harms as proportionate to the overall utilitarian calculus of benefit and harm (however dubiously mea-

sured). The only way out presented by this framework is to secure for oneself an exception from the worst effects of the creeping default pollution encasing the globe. Mobility of all sorts—physical, psychological, emotional, cultural, national, economic—becomes the passport of untethering that allows survival, the goal becoming to stay just ahead of new waves of pollution fed by the material effluent produced by commodified forms of mobility. Rather than attending to degraded default commons, exceptionalism aims to maximally delay the collective fate from catching up to the individual. This requires disassociating oneself from previous associations, rejecting all allegiances, and betraying anyone and anything should such action permit continued mobility toward the imaginary of escape velocity. Attempting to create a “personal commodity bubble” to momentarily protect oneself while failing to address the collective harm creates additional pollution: in the process of attempting to delay reckoning with pollution, one makes even more of it (Szasz 2007). Instead of confronting the ecological and social crisis, the goal of the shared project of environmental and social justice, elite exceptionalism opts out of the shared fate of humanity (Latour 2018). Salvation itself becomes commodified through the half-baked solution that economic mobility allows buying one’s way out of the Chemical Anthropocene, creating an “inverted quarantine” (Szasz 2007: 4) of filters, armor, safe spaces, and other barriers—technologies of distancing—to protect the paying consumer against the increasingly polluted commons.

The chemical industry has been quite aware of the need to downplay the risk of their chemicals, since they wish for consumers to buy their risk-laden products. By simply failing to mention full chemical compositions, denying that there are known harms, and instead directing focus to the virtues of their products, the industry subdues most of us into making real dangers disappear into the everydayness of our experience. The chemical industry defends its actions by emphasizing its adherence to chemical regulations, thus borrowing people’s trust in government oversight to exculpate its own responsibility and provide cover for compromising worker and consumer health for the sake of profit. By making the appeal of new conveniences commonplace enough—aware that most who would be the worst-affected by the health harms are too busy to reflect on the often long-term delayed health harms of chemical exposure—the chemical industry is effectively indemnified (for the short term, at least). The irony that those suffering the most from chemical harms are precisely those whose lives are already strained with other exigencies means that the industry counts on their silence and compliance. This industry formula for repressing harms is being rewritten, as environmental organizations are being replaced by environmental justice organizations (Bakari 2019), often growing from the most affected communities, refocusing from protecting imaginaries of the wilderness to standing in solidarity with the lives and areas that people inhabit.<sup>3</sup>

Scientific disputes on the toxicity of a given chemical often are proxies for political and ideological disagreements on who or what is expendable (Anderson 2004). Instead of simple cost-benefit analyses, disagreements move from terrain to terrain, depending on which actor has a stronger foothold in that area. For example, Monsanto attempted to counter strong ecotoxicology research showing the carcinogenicity of glyphosate with epidemiological studies they felt undermined the ecotoxicology assessments during and immediately following the landmark International Agency for Research on Cancer (IARC) assessment (Farmer and Koch 2015). Many chemical analyses look at chemicals in isolation rather than in their formulations as commercially available and applied. Regulatory agencies such as the European Union’s EFSA (European Food Safety Authority) take a “controlled experimental tiered risk assessment approach, giving results that are difficult to extrapolate to a real-world situation” (Vijver et al. 2017: 860). By determining regulatory decisions based on toxicology analyses of single chemicals rather than the admixtures the “active” ingredient comes housed in, the possibility for accurately assessing exposures plummets. While Europe’s Registration, Evaluation, Authorization and Restriction

tion of Chemicals (REACH) regulation laudably aims to substitute out high-risk chemicals for lower-risk chemicals, its analysis focuses on the “intrinsic properties of chemical substances”—as if chemicals affected all bodies the same, or abstained from interacting with their various environments (European Commission 2021).

### **Disaster Capitalism in the Chemical Anthropocene**

During the coronavirus pandemic, on both sides of the Atlantic the plastic industry has attempted to exploit people’s Lady-Macbeth-like fear of touching surfaces to “leverage more marketing for single-use products” like plastic bags and rolling back environmental regulations, according to US Senator Tom Udall (Udall and Lowenthal 2020). With the plastic waste stream entering oceans (already saturated, as the Great Pacific Plastic Gyre indicates) predicted to triple in the next 20 years (Pew Charitable Trusts 2020)—enough plastic contamination for 50 kilograms for every meter of coastline worldwide—the resistance of the petrochemical industry against reducing plastic use or shifting to bioplastics has been intense and unrelenting (Collins 2010; Freinkel 2011). The plastic industry’s pandemic rentier-seeking behavior, characteristic of “disaster capitalism” (Klein 2008), opportunistically seized a moment of collective trauma to roll back hard-fought environmental and social political gains through exploiting the policy free-for-all during a state of emergency.

Half-measure regulations end up producing “pollution havens” and bubbles of heavily and less polluted areas, rather than minimizing overall pollution. While many countries are locked into a race to the bottom, especially the United States and China seem unable to exit from permissiveness with minimal requirements for newly developed chemicals to enter the market (Aşıcı and Acar 2016; Rasli et al. 2018; Rosen 2005; UN News 2020; Zhao and Percival 2017).<sup>4</sup> Such games of economic one-upmanship, adopting the stance that “if we don’t invent it or allow it, the other team will,” removes traditional restraints from technoscience. By placing first-on-market advantages above all other ecological or health concerns, different companies worldwide are locked into a chemical arms race, holding humanity and the Earth hostage.

Such zero-sum competitive impulses spill over from companies to governments. Governments (or at least portions of them [Harrison 2019]) beholden to chemical manufacturers can do tricky things, like open a public input process for public comment but not list the public comment on the new proposed rule in the federal register, where the public can see the time frame in which they must give crucial scientific feedback. This is exactly what happened with the German agribusiness company BASF’s US application to sell the herbicide isoxaflutole (brand name Alite 27). When a science policy analyst from the Center for Food Safety asserts that “[t]his is basically an herbicide that shouldn’t be approved at all for any use. It’s that bad really on both the human health and environmental fronts,” to not let the public health and environmental science community know about the public comment opportunity (instead the US Environmental Protection Agency [EPA] gathered 54 public comments exclusively from BASF and their business partners lauding the new chemical) is to commit an unethical if not downright criminal act (Hettinger 2020). One can see here that the problem involves more than just the chemical industry. Ironically (or cynically), in announcing their decision to permit use of this herbicide on GMO soybeans designed to withstand the chemical, the EPA explicitly noted their “careful consideration of public input” (US Environmental Protection Agency 2020; see also Hettinger 2020). Instead of interacting with the feedback from government, scientists, and civil society, the chemical industry, like many other industries, has become involuted, bent on refashioning its environment to meet its own single-metric, profit-driven interest.

### ***Settlements as the Price of Doing Business***

Johnson and Johnson's arsenic-containing baby powder, Bayer's glyphosate, the tobacco industry's cigarettes, and Purdue Pharmaceuticals' oxycodone are all members of a select circle of deadly products for which massive class action settlements have occurred, and yet these products continue nonetheless to be sold on the market. Settlements, instead of damning a product into removal from markets, have instead become backdoors to sustaining the legality of known toxins, deflecting acknowledgment of wrongdoing (Bullard 2000; Percival 1987; Christopher Taylor 2004). Settlements exculpate companies from having to clean up their mess, and they enable them to perpetuate externalizing the costs of business. In the tobacco case, one of the weaknesses of the Master Settlement Agreement, which awarded to US states a record-breaking \$240 billion distributed over 25 years, is that it only further entrenched the tobacco industry as part of the deal, as payouts were scheduled over two-and-half decades, securing the industry ample time to pivot to electronic cigarettes while continuing operation of a commercial industry known to kill one in every two of its consumers (Givel and Glantz 2004; Hendlin et al. 2017). Likewise, the June 2020 Bayer US glyphosate settlement did not ban the product from use or manufacture. Instead, the payouts acted effectively as hush money while populations in the United States and around the world—disproportionately people of color and the poor—continued (and continue) to be exposed to these chemicals (Gillam 2020). Settlements that allow the continued sale of harmful products raise the following questions: While the petitioning parties will be financially compensated, what about future injured parties affected by negligent states not taking the message of an injury settlement to heart? Will the future-affected be gagged from receiving their own settlement for injuries that could and should have been prevented? Will such plaintiffs not only sue companies, but also negligent states?

To indicate how the investment community views the severity of the US glyphosate settlement, Bayer's stock price actually *increased* immediately after the \$10.9 billion settlement was announced, suggesting that the real price of Monsanto/Bayer's culpability was estimated to be much higher (Sier 2020). Major investment bank analysts like those from Bernstein and Deutsche Bank commented: "While this undoubtedly constitutes a large amount of money, we believe that it provides a reasonable degree of finality to the litigation issue, and that it removes a significant overhang on the investment case" (Sier 2020). Settling for this amount not only bought Bayer relief from the tens of thousands of open lawsuits against Roundup/glyphosate, but also included \$400 million to settle open litigation against Monsanto's sought glyphosate replacement (dicamba), as well as sealed further environmental claims for glyphosate-related waterway contamination (\$820 million). Bayer netted three potential open claims in one deal. Going into the settlement, Bayer CEO Werner Baumann made explicit that the company only would consider deals that would allow it to continue selling glyphosate-based products (Liu 2020). Likewise, despite its 2017 \$670 million settlement, DuPont continues to manufacture and sell Teflon-coated products around the world, harming customers and factory workers alike every day it continues to do so (Nicole 2013; Percival 1987; Rasli et al. 2018).

### **Different Chemical, Same Pattern**

Surveying the Chemical Anthropocene through industry-dominated sociotechnical imaginaries reveals that the current politics of toxics is concocted so that even when environmental justice, ecological justice, and public health victories occur, the public still loses. From whack-a-

mole chemical regulation—where the chemical industry expects eventual regulation and delegitimization of toxic products, and so lines up replacement chemicals—to accepting fines and settlements as a cost of doing business, the industry’s ability to control the frame of chemical imaginaries has been impressive against popular movements and public scrutiny. The following case studies depict instances of replicated tactics of entrenchment suppressing democratic decision-making regarding the true costs of chemicals.

### ***Flame Retardants (PBDEs): The Power of Leverage***

The responsibility for large and rich governments to regulate chemicals could not be more urgent. The case of fire retardants is a case in point. Pressured to make a firesafe cigarette in the 1970s, the tobacco industry instead made up excuses for why it could not create a firesafe self-extinguishing cigarette, and instead devised a ruse of mass proportions to hide behind. It blamed furniture as the real driver of the frequent smoldering cigarette fires and deaths, and in the process created (yet another) completely avoidable (and previously less pressing) public health emergency of polybrominated diphenyl ethers (PBDEs including halogenated and organophosphate) flame-retardant exposures.

Colluding with the chemical industry, which was eager to make use of a chemical it could not immediately monetize but discovered had (overstated) flame-resistant properties (Callahan and Roe 2012a), the tobacco industry pushed via front groups and proxies—including firefighter associations—to foist the blame of cigarette home fires on “faulty” furniture. As Philip Morris (1984) executives put it during a 1984 private corporate affairs meeting in New York: “We have put a huge amount of time into helping all the organise[d] groups of professional and volunteer fire-fighters . . . And then when we need them to stand up and say, [it is] not cigarettes that cause fire, in 99.9 percent of the cases, we get theri (*sic*) cooperation.” The tobacco industry insinuated former tobacco industry executive Peter Sparber in the National Association of State Fire Marshals, who eventually guided the group to push for flame-retardant legislation (Callahan and Roe 2012b).

Heavily pushed by the American Chemistry Council’s North American Flame Retardant Alliance, California’s flame-retardant test Technical Bulletin (TB) 117-1975 became the gold standard copied worldwide, with many items exceeding the recommended levels. Because California is the United States’s largest market for just about everything and a key commerce portal for Asia, manufacturers do not wish to create alternative manufacturing processes just for California, so they adopted the California standard, which resulted in pouring pounds of bromated flame retardants into every sofa, chair, plush toy, and baby carriage made. In the late 1970s, flame retardants were even dutifully sprayed on children’s pajamas (Dishaw et al. 2014). As a result, American babies were (and still are) born with the highest levels of PBDEs in their blood of any in the world (Lam et al. 2017). Scientists have doubted whether more lives are saved or sacrificed due to the now ubiquitous exposure to flame retardants (Shaw 2010). PBDE flame retardants have since been linked to increased cancer incidence, developmental problems, lower IQ, and impaired fertility (Grandjean and Landrigan 2014; Lam et al. 2017).

Shortly after the 1998 Master Settlement Agreement, the tobacco industry gave up their quest to blame furniture for cigarette-caused fires, but Sparber pivoted to work for the chemical industry, continuing lobbying, under the cover of firefighter organizations, for flame retardants proven to harm human health and be ineffective (Callahan and Roe 2012b). The chemical industry hired the public relations firm Burson-Marsteller, which created a front group called Citizens for Fire Safety, with a paid front man named David Heimbach, who made the rounds

telling fabricated but horrific stories about babies getting burned to death in order to scare lawmakers away from repealing the flame-retardant requirement as evidence mounted of PBDEs' public health harms (Callahan and Roe 2012a).

In response, 150 scientists signed the San Antonio Statement on Brominated and Chlorinated Flame Retardants, arguing that flame retardants contain hazardous persistent organic pollutants (POPs) and are less effective compared to other means of fire suppression (DiGangi Joseph et al. 2010). Many firefighters vehemently oppose the use of these fire retardants, as they pose toxic inhalation risks while they are on duty extinguishing fires (Glenza and Aratani 2019). Only after Pulitzer-Prize-winning journalists exposed the tobacco-chemical flame-retardant conspiracy did California move in 2013 to finally repeal TB 117-1975 and replace it with TB 117-2013, which by 2015 allowed the sale of flame-retardant-free furniture and other items in the state, freeing up manufacturers worldwide to revert to producing household goods *sans* flame retardants.

### ***Cellulose Viscose (Rayon): The Siren of Innovation for Mass Consumption***

The first synthetic fiber to be mass manufactured, cellulose viscose, became “the prototype of a multinational business enterprise, an early model of what would become the dominant modus operandi for large business entities after World War II” (Blanc 2016: 193). At the time of its market introduction in the 1910s and 1920s, viscose was heralded as making luxury goods (such as silk pantyhose available through their viscose rayon variety) accessible to wider populations, as many chemical and commercial inventions have claimed and indeed done. From increased heart attacks among factory workers to severe mental health issues from inhaling fumes (Blanc 2016), however, viscose also causes countless manufacturing workers to die prematurely and releases carbon disulfide into the atmosphere (Blanc 2009, 2016). Indicting Occupational Safety and Health Administration (OSHA) for lax, industry-friendly carbon disulfide regulations (they rejected a scientifically recommended 1 part per million [ppm] standard in favor of a 20 ppm air exposure limit in place since the 1930s), medical doctor and historian Paul Blanc places viscose's environmental and health costs at the same maximum tier as asbestos. He asks the disconcerting question—because it has no scientific but only a political answer—how much accumulated death and evidence is required after the introduction of new chemicals and technologies before we decide to reverse our steps?

Pantyhose for the masses was the entry point for the rayon industry, and the 1970s cemented the trend of cheaply produced synthetic clothes. But its downsides became apparent as factory workers became sick and died. Following an already familiar pattern of colonial waves of chemical imperialism, at mid-century after domestic publics became indignant over worker harms, rayon manufacturing was shipped overseas, both distancing the harms (out of sight, out of mind) and creating new markets for the materials (Blanc 2016).

In lockstep with the industry playbook of replacing chemicals—but not processes—with marginally different ones, the industry introduced so-called “green” viscose made from bamboo fibers, which was another act of what the Federal Trade Commission (FTC) (2009) called “bamboo-zling” customers. As the FTC explains: “Rayon is a man-made fiber created from the cellulose found in plants and trees and processed with a harsh chemical that releases hazardous air pollutants. Any plant or tree could be used as the cellulose source—including bamboo—but the fiber that is created is rayon.” Yet again, the panacea to the problem is provided by the same companies that created the toxic harms in the first place, placating the public to sustain unsustainable business practices while making minimal deviations from the status quo, with the consequence of minimally mitigating the harms.

### ***PFAS (Teflon): The Power of Denial***

The original “forever chemicals,” the family of perfluoroalkyl or polyfluoroalkyl substances (PFAS) are found in 99 percent of American bodies and in organisms living in far-flung corners of the Earth, and are transferred intergenerationally (Environmental Working Group 2018). Perhaps as many as 110 million Americans are regularly exposed to contaminated tap water containing at least one of the nearly 5,000 types of PFAS chemicals (Evans et al. 2020). The majority of these exposures occur among populations that are already disproportionately in contact with other chemical toxins. Exposure to PFAS, even in extremely small quantities, causes cancers, reproductive and immune system harm, metabolic dysfunction, and other serious diseases (Environmental Working Group 2018; Graber et al. 2019; Nicole 2013). Since 1946, 3M (Scotchgard and Gore-Tex) and DuPont (Teflon) co-produced PFOA (which DuPont termed “C-8”). Like many chemicals described here, and much like the birth-defect-producing chlorpyrifos, PFOA is biopersistent, meaning that it does not readily degrade, and is passed down through generations, bioaccumulating and makes existing toxin exposures even worse.

Through factory surveys, worker complaints, and its secret internal scientific studies, DuPont knew about the toxic effects of C8 as early as 1950, and in 1961 internal scientists warned about liver damage (Environmental Working Group 2018). Research by 3M, DuPont, and a Stanford University study in the 1960s already produced data detailing C8’s harms (Environmental Working Group 2018). By the 1970s and 1980s, both 3M and DuPont were taking precautions with exposed workers, including reassigning pregnant female workers due to C8’s known reproductive harms (Arenson 1961; Ingalls 1981). As the serious health harms of PFOA became increasingly clear to both companies, they took different tacks in reconciling their businesses with the harms of their product.

3M positioned as praiseworthy its 2002 “voluntarily phase out [of] production of PFOA and PFOS globally as a precautionary measure”; yet, on the very same corporate webpage they deny the science of these persistent endocrine disruptors: “While some research has indicated possible associations with certain biomarkers or health outcomes in people for PFOA and PFOS, results across studies examining these endpoints have found either inconsistent or conflicting observations and do not show causation” (3M 2020). Such slippery conclusions are scientifically false and a testament to the company’s rearguard desire to indemnify itself against lawsuits. The current science is indisputable in this regard; even the FDA has moved to phase out perfluorinated alkylated substances from to-go containers such as pizza boxes due to the unambiguous harms (even if their generous “voluntary” phaseout by the main food container manufacturers aims to minimize “potential market disruptions to food packaging supply chains” rather than maximize the public health protections) (Office of the Commissioner 2020).

DuPont, on the other hand, feared moving to another chemical (such as C-6), as they figured “C8 is the devil we know,” whereas a new chemical might be even worse—“the devil we don’t know” (Playtis and DuPont 1991). Such iatrogenic concerns are understandable, as DuPont witnessed the unfolding of the contamination of the groundwater of Parkersburg, West Virginia, downstream from their Teflon factory (Soechtig and Seifert 2019). After a class action lawsuit from injured parties in Parkersburg formed the C8 Health Project, DuPont settled without admitting liability to the EPA for “concealing its knowledge of PFOA’s toxicity and presence in the environment in violation of the Toxic Substances Control Act” (Rich 2016). The company proceeded to shift production from PFOA to other PFAS chemicals. As experts at the University of California, San Francisco maintain, however, “[t]hrough the specific PFAS chemicals originally used to make Teflon and Scotchgard (PFOA and PFOS, respectively) have been banned in the

US, the PFAS chemicals that have replaced them may be just as toxic” (Toepel 2019). DuPont’s premonition about the devil they did not yet know may have turned out to be correct.

### ***Glyphosate: The Most Used Pesticide in History***

No pesticide in history has been more applied than glyphosate and glyphosate-based herbicides (GBHs). Available originally in 1974 as Roundup, and since appearing in nearly 1,000 formulations and products, glyphosate was the original herbicide for which the first genetically modified organisms (GMOs) were commercially built to withstand. Glyphosate has been Monsanto’s (now Bayer’s) star chemical; in recent years GBHs accounted for nearly 50 percent of Monsanto’s total revenue (Henderson et al. 2019). Glyphosate has been called a “once in a century” pesticide for the great boon it confers on agrobusinesses, as it is effective in killing weeds and is relatively safe compared to previous Green Revolution chemicals, such as chlorpyrifos (Duke and Powles 2008). But such comparisons are misleading.

Mounting evidence show GBHs to be far from benign, as did the prestigious IARC, which found GBHs to be “probably carcinogenic to humans” in March 2015 (Guyton et al. 2015), sending Monsanto and industry-friendly chemical regulatory agencies around the world scrambling to counter IARC’s status quo destabilizing designation. Soon, a class action lawsuit was underway, eventually amounting to over 140,000 members—mostly groundskeepers, janitors, and farmers—who had contracted non-Hodgkin’s lymphoma from regular contact with GBHs. Just before the first jury verdicts in California courts delivered billions of dollars in damages to single parties, Bayer bought Monsanto for US\$63 billion and then promptly lost the even greater sum of €57.7 billion in share value, an act described as the “biggest destruction of capital in German stock market history” (Wisner 2018).

The anthropocentric focus of glyphosate regulation is the twin harm of the effective compartmentalization of the substance, with Monsanto and chemical-industry-captured government agencies only assaying the pure chemical of glyphosate rather than examining the toxicity of the admixtures that commercial varieties actually come in. Coincidences of atrazine (another popular toxic herbicide) and GBHs increase genotoxicity damage more than both in isolation (Roustan et al. 2014; dos Santos and Martinez 2014). This “cocktail effect” of the synergistic—or more accurately, dysergistic—effects of these combined chemicals is one of the gaping holes of chemical regulation in Europe, the United States, and elsewhere.

Co-formulants of GBHs also intensify their harms. For example, the European Union banned the adjuvant polyethoxylated tallowamine in their 2016 reauthorization because of dysergistic effects causing worse human health effects than glyphosate alone (European Commission 2016; Nagy et al. 2020; Sihtmäe et al. 2013). One might ask why the EU formulation free from this toxic adjuvant has not become the standard elsewhere, and why formulations in various countries differ.

Some scientists have been reticent about a glyphosate ban because of fears of even worse replacement chemicals; farm owners have resisted bans because of entrenched chemical path dependency. This suggests that campaigns to ban PFAS or glyphosate, for instance, must be accompanied by the larger challenge of reducing synthetic chemical inputs in agriculture and consumer goods in general—and instantiating these changes in law. Alternative pest and weed management strategies are required in order for industry to disembark from the chemical treadmill.

Due to chemical industry lobbying, advertising, and curated farmer dependency, farmers often defend industry interests when threatened by attempts to ban chemicals they depend on without a clear transition trajectory (Wagner 2008). Consumer advocacy groups and farm owners have often been pitted against each other over glyphosate, with farmers defending contin-

ued use of the agrochemical, even though farm workers (and their families) are much more exposed to dermal and airway harms (the most harmful ingestion pathways) than consumers are (Myers et al. 2016). This pesticide Stockholm syndrome further entrenches harmful pesticides and deepens farmer identity with the industry, despite their lived experiences of ill health. While environmental justice movements have awakened many farmers' indignation at chemical exposure, agrochemical industry strategies aim to reframe farmers' perceptions of pesticide regulations as economic threats rather than as protections aimed to safeguard their health.

## Unequal Exposures and Protections

Chronic health conditions have risen over the last three decades for children and young adults (Cleave et al. 2010), and they are correlated with increased chemical exposure, especially for endocrine-disrupting chemicals such as dichlorodiphenyltrichloroethane (DDT), phthalates, bisphenol A (BPA), and PBDEs (polybrominated diphenyl ethers in flame retardants) found in pregnant mothers (Woodruff et al. 2011). Considering the bioaccumulation of chemicals in our bodies and environment, this is not surprising; our bodies and social systems can only take so much before they succumb to chemical collapse.

The ambitions of chemical imperialism consistently seek new markets especially as domestic regulations mature. One of the basic problems with the Chemical Anthropocene is that precisely those with the most power to make decisions about the future of chemical regulation are insulated from their consequences. These asymmetries of exposure, with those profiting off toxins removing themselves as far as possible from the actual production and use of these harmful chemicals, epitomizes NIMBYism. Health disparities are not consequences of the Chemical Anthropocene, but predicates. Without the unequal distribution of disease and profit, the cost for manufacturers and companies would be too high. If every CEO was exposed to the toxins their company produces to the degree frontline workers and local communities are, injurious chemicals would be phased out immediately.

If the history of chemical production marks a pattern of one "unsuspected" consequence after another, what conclusions can be drawn for regulatory policy? The "safe until proven harmful" model has not worked. Once a chemical has been approved for market, it is extremely difficult to take it off (let alone remove it from the environment), especially once it has gained traction for multitudinous uses and become indispensable to the economy. The harms of most chemicals coming to market are unknown, and often epidemiology requires decades of data to catch up with the exposures, with another time lag as the chemical industry and its government allies fight scientific evidence that would restrict or remove the chemical (Cranor 2019; Markowitz and Rosner 2002). Less than one percent of all chemicals produced in 25,000 pounds or more per year in the United States have been fully tested by the EPA's Chemical Review Program (Krimsky 2017). This failure of chemical regulation, in the United States and Europe, but also globally, creates a free-for-all where the toxicity of newly marketed chemicals is partially known at best and the interactions between new chemicals and preexisting ones in the environment and in bodies have yet to be systematically researched. The prevailing sociotechnical imaginaries of chemical regulations systematically fail to take into account the dysergistic cross-effects, epidemiological science documenting health harms, and the possibility of preemptive regulatory policies. Until the willful ignorance of these exclusions and the industry's financial conflicts of interest are accounted for at all levels of society, environmental injustices will proliferate, as they have at each stage of the chemical industry's planetary colonization.

But the struggle for redefining chemical imaginaries continues. The United States National Academies of Science, Medicine and Engineering in 2018 investigated how toxicology testing

could shift from being an *ex post* to an *ex ante* procedure (Standing Committee on Emerging Science for Environmental Health Decisions et al. 2018). Their report rejects the predominating “safe until proven to be toxic” model and suggests a more precautionary process.

Historical analysis suggests that if we wish to halt the Chemical Anthropocene, which has already changed our species makeup and that of countless other organisms, we must retool the institutions upholding dysfunctional chemical imaginaries. This requires democratic institutions promoting feedback and dialog between scientists, policymakers, and marginalized populations to institute precautionary approaches based on real-time reporting (Kitcher 2001; Oreskes 2019). Globally, current political systems obstruct such dialogs, often frustrating those most knowledgeable about their own lived experiences in the Chemical Anthropocene from doing something about it. Human rights frameworks, including the United Nations’ Sustainable Development Goals, endow denizens and communities with unalienable rights to refuse toxic exposures. Upholding these rights to health, however, may require refraining from some of the conveniences that a toxin-perfused lifestyle provides. Such trade-offs should be made conscientiously, rather than perpetuating NIMBYism. To tackle the environmental injustices of toxins, we must move from the injustice-multiplying “not in my backyard” ethos to the solidarity-producing “not in *anybody’s* backyard” (NIABY) ethos. There may never be full substitutes for “better living through chemistry.” We must fully acknowledge and accept the necessary material trade-offs that environmental justice entails. Until then, toxic chemicals will not go away, but aggravate the scars in the geological record of our bodies and ecologies.

#### ■ ACKNOWLEDGEMENTS

I thank my colleagues at the University of California, San Francisco at the Center for Tobacco Control Research and Education (CTCRE) and Environmental Health Initiative (EHI) for their encouragement to look cross-sectionally at industrial epidemics, as well as the librarians of the UCSF Industry Documents Library, Kate Tasker and Rachel Taketa, for their help identifying various source documents and continuing to expand this invaluable online public collection of previously secret industry documents. The Dynamics of Inclusive Prosperity Initiative at Erasmus University Rotterdam has provided key staff assistance and funding to my co-directed projects Agribusiness and its Alternatives as well as PFAS Exposures as Environmental Crime, which have greatly facilitated the writing of this article.

■ **YOGI HALE HENDLIN** is Assistant Professor in the Erasmus School of Philosophy and Core Faculty in the Dynamics of Inclusive Prosperity Initiative at Erasmus University Rotterdam, as well as Research Associate in the Environmental Health Initiative at the University of California, San Francisco. Through 15 years of researching the Industry Documents Library at UCSF, Hendlin has examined how various industries self-identify and how the industrialization of business has led to environmental and ecological injustices, becoming disease vectors precipitating industrial epidemics. Email: hendlin@esphil.eur.nl

#### ■ NOTES

1. Regarding recognition that we are living in the “Chemical Anthropocene,” see Vane et al. (2011) and Rockström et al. (2009); regarding the term itself, see Arcuri and Hendlin (2019).

2. A clear example of the denialist addiction to extract profit until the house of cards falls is the warning issued by 66 of the world's largest banks that global GDP will fall 25 percent unless immediate and large-scale climate action occurs while these same banks simultaneously continue to invest in fossil fuel projects (Network of Central Banks and Supervisors for Greening Financial Services 2020; Toscano and Foley 2020).
3. This might be thought of as the somewhat opportunistic environmental justice turn of environmental NGOs. While the refocus on environmental justice has certainly helped foreground the harms of ethnic minorities and the poor from chemicals, it also lays bare the host of environmental harms previously not on the radar of the big international environmental NGOs.
4. Other arms races include the China–US aggrandizement of research with stem cells and human enhancement, as well as with artificial intelligence.

## ■ REFERENCES

- 3M. 2020. "History of PFAS and 3M." *3M's Commitment to PFAS Stewardship*, 3 August. [https://www.3m.com/3M/en\\_US/pfas-stewardship-us/pfas-history/](https://www.3m.com/3M/en_US/pfas-stewardship-us/pfas-history/).
- Agard-Jones, Vanessa. 2013. "Bodies in the System." *Small Axe: A Caribbean Journal of Criticism* 17 (3): 182–192. doi:10.1215/07990537-2378991.
- Alaimo, Stacy. 2010. *Bodily Natures: Science, Environment, and the Material Self*. Bloomington: Indiana University Press.
- Allen, Joseph. 2016. "Stop Playing Whack-a-Mole with Hazardous Chemicals." *Washington Post*, 15 December. [https://www.washingtonpost.com/opinions/stop-playing-whack-a-mole-with-hazardous-chemicals/2016/12/15/9a357090-bb36-11e6-91ee-1addfe36cbe\\_story.html](https://www.washingtonpost.com/opinions/stop-playing-whack-a-mole-with-hazardous-chemicals/2016/12/15/9a357090-bb36-11e6-91ee-1addfe36cbe_story.html).
- Allen, Joseph. 2017. "Harmful Chemicals Removed from Products Often Replaced with Something as Bad or Worse." *Harvard News*. 25 January. <https://www.hsph.harvard.edu/news/hsph-in-the-news/harmful-chemicals-removed-from-products-often-replaced-with-something-as-bad-or-worse/>.
- Anderson, Paul Nicholas. 2004. "What Rights Are Eclipsed When Risk Is Defined by Corporatism? Governance and GM Food." *Theory, Culture & Society* 21 (6): 155–169. doi:10.1177/0263276404050460.
- Appadurai, Arjun. 1990. "Disjuncture and Difference in the Global Cultural Economy." *Theory, Culture & Society* 7 (2–3): 295–310. doi:10.1177/026327690007002017.
- Arcuri, Alessandra, and Yogi Hale Hendlin. 2019. "The Chemical Anthropocene: Glyphosate as a Case Study of Pesticide Exposures." *King's Law Journal* 30 (2): 234–253. doi:10.1080/09615768.2019.1645436.
- Arenson, Gerald. 1961. "Toxicity of Teflon Dispersing Agents." *Industry Documents Library*, 9 November. <https://www.industrydocuments.ucsf.edu/docs/#id=snpw0228>.
- Aşıcı, Ahmet Atıl, and Sevil Acar. 2016. "Does Income Growth Relocate Ecological Footprint?" *Ecological Indicators* 61: 707–714. doi:10.1016/j.ecolind.2015.10.022.
- Badgley, Catherine, Jeremy Moghtader, Eileen Quintero, Emily Zakem, M. Jahi Chappell, Katia Avilés-Vázquez, . . . , and Ivette Perfecto. 2007. "Organic Agriculture and the Global Food Supply." *Renewable Agriculture and Food Systems* 22 (2): 86–108. doi:10.1017/S1742170507001640.
- Bakari, Mohamed. 2019. "Marrying Anthropocentrism to Ecocentrism: The Rising Voices of Dissent in American Environmentalism." *American Studies Journal* 66. doi:10.18422/66-01.
- Bardon, Adrian. 2019. *The Truth about Denial: Bias and Self-Deception in Science, Politics, and Religion*. New York: Oxford University Press.
- Bartley, Tim. 2018. *Rules without Rights: Land, Labor, and Private Authority in the Global Economy*. Oxford: Oxford University Press.
- Bauman, Zygmunt, and Leonidas Donskis. 2013. *Moral Blindness: The Loss of Sensitivity in Liquid Modernity*. Chichester, UK: Polity.
- Beck, Ulrich. 1992. *Risk Society: Towards a New Modernity*. Thousand Oaks, CA: SAGE Publications.

- Blanc, Paul D. 2009. *How Everyday Products Make People Sick: Toxins at Home and in the Workplace*. Berkeley: University of California Press.
- Blanc, Paul D. 2016. *Fake Silk: The Lethal History of Viscose Rayon*. New Haven, CT: Yale University Press.
- Braveman, Paula, and Laura Gottlieb. 2014. "The Social Determinants of Health: It's Time to Consider the Causes of the Causes." *Public Health Reports (Washington, D.C.: 1974)* 129 (Supp 2): 19–31. doi:10.1177/00333549141291S206.
- Brickman, Ronald, Sheila Jasanoff, and Thomas Ilgen. 1985. *Controlling Chemicals: The Politics of Regulation in Europe and the United States*. Ithaca, NY: NCROL.
- Bronstad, Amanda. 2020. "Bayer Agrees to Pay Up to \$10.9B to Resolve Roundup Lawsuits." *Law.Com*, 24 June. <https://www.law.com/2020/06/24/bayer-agrees-to-pay-up-to-10-9b-to-resolve-roundup-lawsuits/>.
- Bullard, Robert D. 1989. *Dumping in Dixie: Race, Class, and Environmental Quality*. Boulder, CO: Westview Press.
- Callahan, Patricia, and Sam Roe. 2012a. "Fear Fans Flames for Chemical Makers." *Chicago Tribune*, 6 May. <https://www.chicagotribune.com/investigations/ct-met-flame-retardants-20120506-story.html>.
- Callahan, Patricia, and Sam Roe. 2012b. "Big Tobacco Wins Fire Marshals as Allies in Flame Retardant Push." *Chicago Tribune*, 8 May. <https://www.chicagotribune.com/lifestyles/health/ct-met-flames-tobacco-20120508-story.html>.
- Carson, Rachel. 1962. *Silent Spring*. Boston: Houghton Mifflin.
- Cleave, Jeanne Van, Steven L. Gortmaker, and James M. Perrin. 2010. "Dynamics of Obesity and Chronic Health Conditions among Children and Youth." *JAMA* 303 (7): 623–630. doi:10.1001/jama.2010.104.
- Collins, Craig. 2010. *Toxic Loopholes: Failures and Future Prospects for Environmental Law*. Cambridge: Cambridge University Press.
- Cranor, Carl. 2019. "How the Law Promotes Ignorance: The Case of Industrial Chemicals and Their Risks." In *Science and the Production of Ignorance: When the Quest for Knowledge Is Thwarted*, ed. Janet A. Kourany and Martin Carrier, 165–192. Cambridge, MA: MIT Press.
- Davies, Thom. 2018. "Toxic Space and Time: Slow Violence, Necropolitics, and Petrochemical Pollution." *Annals of the American Association of Geographers* 108 (6): 1537–1553. doi:10.1080/24694452.2018.1470924.
- Di Renzo, Gian Carlo, Jeanne A. Conry, Jennifer Blake, Mark S. DeFrancesco, Nathaniel DeNicola, James N. Martin, . . . , and Kelly A. McCue. 2015. "International Federation of Gynecology and Obstetrics Opinion on Reproductive Health Impacts of Exposure to Toxic Environmental Chemicals." *International Journal of Gynecology & Obstetrics* 131 (3): 219–225. doi:10.1016/j.ijgo.2015.09.002.
- DiGangi Joseph, Arlene Blum, Åke Bergman, Cynthia A. de Wit, Donald Lucas, David Mortimer, . . . and Arnold Schecter. 2010. "San Antonio Statement on Brominated and Chlorinated Flame Retardants." *Environmental Health Perspectives* 118 (12): A516–A518. doi:10.1289/ehp.1003089.
- Dishaw, Laura V., Laura J. Macaulay, Simon C. Roberts, and Heather M. Stapleton. 2014. "Exposures, Mechanisms, and Impacts of Endocrine-Active Flame Retardants." *Current Opinion in Pharmacology* 19: 125–133. doi:10.1016/j.coph.2014.09.018.
- dos Santos, Kelly Cristina, and Claudia B. R. Martinez. 2014. "Genotoxic and Biochemical Effects of Atrazine and Roundup®, Alone and in Combination, on the Asian Clam *Corbicula Fluminea*." *Ecotoxicology and Environmental Safety* 100: 7–14. doi:10.1016/j.ecoenv.2013.11.014.
- Duke, Stephen O., and Stephen B. Powles. 2008. "Glyphosate: A Once-in-a-Century Herbicide." *Pest Management Science* 64 (4): 319–325. doi:10.1002/ps.1518.
- Environmental Working Group. 2018. "What Are PFAS Chemicals, and Where Are They Found?" <https://www.ewg.org/pfaschemicals/what-are-forever-chemicals.html> (accessed July 8, 2021).
- European Commission. 2016. "FAQs: Glyphosate." June 29. [https://ec.europa.eu/commission/press-corner/detail/en/MEMO\\_16\\_2012](https://ec.europa.eu/commission/press-corner/detail/en/MEMO_16_2012).
- European Commission. 2021. "REACH." *Chemicals, Environment*, 26 March. [https://ec.europa.eu/environment/chemicals/reach/reach\\_en.htm](https://ec.europa.eu/environment/chemicals/reach/reach_en.htm).

- Evans, Sydney, David Andrews, Tasha Stoiber, and Olga Naidenko. 2020. "PFAS Contamination of Drinking Water Far More Prevalent Than Previously Reported." *Environmental Working Group*, 22 January. <https://www.ewg.org/research/national-pfas-testing/>.
- Fagin, Dan, and Marianne Lavelle. 2002. *Toxic Deception: How the Chemical Industry Manipulates Science, Bends the Law and Endangers Your Health*. Monroe, ME: Common Courage Press.
- Farmer, Donna, and Michael Koch. 2015. "Email from Heydens, William F to Koch, Michael S Regarding IARC Planning." Gxmn0226. Chemical Industry Documents. <https://www.industrydocuments.ucsf.edu/chemical/docs/#id=gxmn0226>.
- Federal Trade Commission. 2009. "FTC Charges Companies with 'Bamboo-Zling' Consumers with False Product Claims." *Federal Trade Commission*, 11 August. <https://www.ftc.gov/news-events/press-releases/2009/08/ftc-charges-companies-bamboo-zling-consumers-false-product-claims>.
- Freinkel, Susan. 2011. *Plastic: A Toxic Love Story*. Boston: Houghton Mifflin Harcourt.
- Funtowicz, Silvio, and Jerome Ravetz. 1990. "Post-Normal Science: A New Science for New Times." *Scientific European* 169: 20–22.
- Garcia-Johnson, Ronie. 2000. *Exporting Environmentalism: U.S. Multinational Chemical Corporations in Brazil and Mexico*. Cambridge, MA: MIT Press.
- Geyer, Roland, Jenna R. Jambeck, and Kara Lavender Law. 2017. "Production, Use, and Fate of All Plastics Ever Made." *Science Advances* 3 (7): e1700782. doi:10.1126/sciadv.1700782.
- Gillam, Carey. 2020. "Some U.S. Roundup Plaintiffs Balk at Signing Bayer Settlement Deals; \$160,000 Average Payout Eyed." *U.S. Right to Know*, 30 July. <https://usrtk.org/monsanto-roundup-trial-tracker/some-u-s-roundup-plaintiffs-balk-at-signing-bayer-settlement-deals-160000-average-payout-eyed/>.
- Givel, Michael, and Stanton A. Glantz. 2004. "The 'Global Settlement' with the Tobacco Industry: 6 Years Later." *American Journal of Public Health* 94 (2): 218–224. doi:10.2105/AJPH.94.2.218.
- Glenza, Jessica, and Lauren Aratani. 2019. "'It's Killing Us': Why Firefighters Are Battling to Ban Flame Retardants." *The Guardian*, 24 May. <https://www.theguardian.com/us-news/2019/may/24/massachusetts-flame-retardants-firefighters-safety-cancer>.
- Graber, Judith M., Cora Alexander, Robert J. Laumbach, Kathleen Black, Pamela Ohman Strickland, Panos G. Georgopoulos, . . . and Elizabeth G. Marshall. 2019. "Per- and Polyfluoroalkyl Substances (PFAS) Blood Levels after Contamination of a Community Water Supply and Comparison with 2013–14 NHANES." *Journal of Exposure Science & Environmental Epidemiology* 29 (2): 172–182. doi:10.1038/s41370-018-0096-z.
- Grandjean, Philippe, and Philip J. Landrigan. 2014. "Neurobehavioural Effects of Developmental Toxicity." *The Lancet Neurology* 13 (3): 330–338. doi:10.1016/S1474-4422(13)70278-3.
- Guinier, Lani, and Gerald Torres. 2003. *The Miner's Canary: Enlisting Race, Resisting Power, Transforming Democracy*. Cambridge, MA: Harvard University Press.
- Guyton, Katherine Z., Dana Loomis, Yann Grosse, Fatiha El Ghissassi, Lamia Benbrahim-Tallaa, . . . , and Neela Guha. 2015. Carcinogenicity of Tetrachlorvinphos, Parathion, Malathion, Diazinon, and Glyphosate." *Lancet Oncology* 16 (5): 490–491. doi:10.1016/S1470-2045(15)70134-8.
- Habermas, Jürgen. 1987. *The Theory of Communicative Action: Lifeworld and System: A Critique of Functional Reason*. Vol. 2. Boston: Beacon Press.
- Harrison, Jill Lindsey. 2019. *From the Inside Out: The Fight for Environmental Justice within Government Agencies*. Cambridge, MA: MIT Press.
- Harvey, David. 2006. *Spaces of Global Capitalism: A Theory of Uneven Geographical Development*. London: Verso.
- Henderson, A.M., J.A. Gervais, B. Luukinen, K. Buhl, D. Stone, A. Cross, and J. Jenkins. 2019. "Glyphosate General Fact Sheet." Oregon State University Extension Services. National Pesticide Information Center, March. <http://npic.orst.edu/factsheets/glyphogen.html>.
- Hendlin, Yogi Hale. 2014. "From Terra Nullius to Terra Communis: Reconsidering Wild Land in an Era of Conservation and Indigenous Rights." *Environmental Philosophy* 11(2): 141–74. doi:10.5840/envirophil20143205.

- Hendlin, Yogi Hale, Jesse Elias, and Pamela M. Ling. 2017. "The Pharmaceuticalization of the Tobacco Industry." *Annals of Internal Medicine* 167 (4): 278–280. doi:10.7326/M17-0759.
- Hettinger, Jonathan. 2020. "EPA Sidesteps Normal Public Process to Approve BASF's Cancer-Linked Pesticide." *Midwest Center for Investigative Reporting, St. Louis Post-Dispatch*, 3 April. [https://www.stltoday.com/business/local/epa-sidesteps-normal-public-process-to-approve-basf-s-cancer-linked-pesticide/article\\_d9863ee7-1412-5d59-81f3-63dfb847e317.html](https://www.stltoday.com/business/local/epa-sidesteps-normal-public-process-to-approve-basf-s-cancer-linked-pesticide/article_d9863ee7-1412-5d59-81f3-63dfb847e317.html).
- Ingalls, R. D. 1981. "C8 Perfluorooctonate—Employee Communication Package." DuPont Confidential Document. Chemical Industry Documents. San Francisco: UCSF. <https://www.industrydocuments.ucsf.edu/chemical/docs/#id=kypw0228>.
- Jasanoff, Sheila, ed. 2004. *States of Knowledge: The Co-Production of Science and Social Order*. London: Routledge.
- Jasanoff, Sheila. 2015. "Future Imperfect: Science, Technology, and the Imaginations of Modernity." In *Dreamscapes of Modernity: Sociotechnical Imaginaries and the Fabrication of Power*, ed. Sheila Jasanoff and Sang-Hyun Kim, 1–33. Chicago: University of Chicago Press.
- Jasanoff, Sheila, and Sang-Hyun Kim, eds. 2015. *Dreamscapes of Modernity: Sociotechnical Imaginaries and the Fabrication of Power*. Chicago: University of Chicago Press.
- Kimmerer, Robin Wall. 2015. *Braiding Sweetgrass: Indigenous Wisdom, Scientific Knowledge and the Teachings of Plants*. Minneapolis: Milkweed Editions.
- Kitcher, Philip. 2001. *Science, Truth, and Democracy*. New York: Oxford University Press.
- Klein, Naomi. 2008. *The Shock Doctrine: The Rise of Disaster Capitalism*. New York: Picador.
- Krimsky, Sheldon. 2017. "The Unsteady State and Inertia of Chemical Regulation under the US Toxic Substances Control Act." *PLOS Biology* 15 (12): e2002404. doi:10.1371/journal.pbio.2002404.
- Lam, Juleen, Bruce P. Lanphear, David Bellinger, Daniel A. Axelrad, Jennifer McPartland, Patrice Sutton, . . . and Lisette Davidson. 2017. "Developmental PBDE Exposure and IQ/ADHD in Childhood: A Systematic Review and Meta-Analysis." *Environmental Health Perspectives* 125 (8): 086001. doi:10.1289/EHP1632.
- Latour, Bruno. 2018. *Down to Earth: Politics in the New Climatic Regime*. Cambridge: Polity.
- Lerner, Steve. 2010. *Sacrifice Zones: The Front Lines of Toxic Chemical Exposure in the United States*. Cambridge, MA: MIT Press.
- Liu, Angus. 2020. "Bayer Extends Baumann's CEO Tenure by 3 Years as Roundup Settlement Talks Move Forward." *Fiercepharma.com*, 11 September. <https://www.fiercepharma.com/pharma/bayer-extends-baumann-s-ceo-tenure-by-3-years-as-roundup-settlement-talks-move-forward>.
- MacKendrick, Norah. 2018. *Better Safe than Sorry: How Consumers Navigate Exposure to Everyday Toxics*. Oakland: University of California Press.
- Markowitz, Gerald, and David Rosner. 2002. *Deceit and Denial: The Deadly Politics of Industrial Pollution*. Berkeley: University of California Press.
- Merchant, Carolyn. 1980. *The Death of Nature: Women, Ecology, and the Scientific Revolution*. New York: Harper & Row.
- Misrach, Richard, and Kate Orff. 2014. *Petrochemical America*. 2nd Revised Ed. New York: Aperture.
- NAACP and Clean Air Task Force. 2017. "Fumes Across the Fence-Line: The Health Impacts of Air Pollution from Oil & Gas Facilities on African American Communities." NAACP Report, November. [www.naacp.org/climate-justice-resources/fumes-across-the-fence-line](http://www.naacp.org/climate-justice-resources/fumes-across-the-fence-line).
- Nabhan, Gary Paul. 2013. *Growing Food in a Hotter, Drier Land: Lessons from Desert Farmers on Adapting to Climate Uncertainty*. White River Junction, VT: Chelsea Green Publishing.
- Nagy, Károly, Radu Corneliu Duca, Szabolcs Lovas, Matteo Creta, Paul T. J. Scheepers, Lode Godderis, and Balázs Ádám. 2020. "Systematic Review of Comparative Studies Assessing the Toxicity of Pesticide Active Ingredients and Their Product Formulations." *Environmental Research* 181 (February): 108926. doi:10.1016/j.envres.2019.108926.
- Network of Central Banks and Supervisors for Greening Financial Services. 2020. "NGFS Climate Scenarios for Central Banks and Supervisors." Paris: Banque de France. <https://www.ngfs.net/en/liste-chronologique/ngfs-publications>.

- Nicole, Wendee. 2013. "PFOA and Cancer in a Highly Exposed Community: New Findings from the C8 Science Panel." *Environmental Health Perspectives* 121 (11–12): A340. doi:10.1289/ehp.121-A340.
- Office of the Commissioner. 2020. "FDA Announces Voluntary Agreement with Manufacturers to Phase Out Certain Short-Chain PFAS Used in Food Packaging." *Food and Drug Administration*, 31 July. <https://www.fda.gov/news-events/press-announcements/fda-announces-voluntary-agreement-manufacturers-phase-out-certain-short-chain-pfas-used-food>.
- Oreskes, Naomi. 2019. *Why Trust Science?* Princeton, NJ: Princeton University Press.
- Pellow, David Naguib. 2007. *Resisting Global Toxics: Transnational Movements for Environmental Justice*. Cambridge, MA: MIT Press.
- Pellow, David Naguib, and Robert J. Brulle, eds. 2005. *Power, Justice, and the Environment: A Critical Appraisal of the Environmental Justice Movement*. Cambridge, MA: MIT Press.
- Percival, Robert V. 1987. "The Bounds of Consent: Consent Decrees, Settlements and Federal Environmental Policy Making." *University of Chicago Legal Forum* 1987 (13): 327–352. <https://chicagounbound.uchicago.edu/uclf/vol1987/iss1/13/>.
- Perrow, Charles. 1999. *Normal Accidents: Living with High-Risk Technologies*. 2nd ed. Princeton, NJ: Princeton University Press.
- Pew Charitable Trusts. 2020. "Breaking the Plastic Wave: A Comprehensive Assessment of Pathways Towards Stopping Ocean Plastic Pollution." *Pew Charitable Trusts*, 7 July 23. <https://www.pewtrusts.org/en/research-and-analysis/articles/2020/07/23/breaking-the-plastic-wave-top-findings>.
- Philip Morris. 1984. "Corporate Affairs World Conference Rye Brook, New York 840913 Workshop—Dealing with the Issues Indirectly: Constituencies." New York: Industry Documents Library. 13 September. <https://www.industrydocuments.ucsf.edu/docs/jrlm0128>.
- Playtis, Anthony, and DuPont. 1991. "Fppw0228—Toxicity Information—C8." UCSF Industry Documents Library, 26 October. <https://www.industrydocuments.ucsf.edu/docs/#id=fppw0228>.
- Proctor, Robert, and Londa L. Schiebinger. 2008. *Agnotology: The Making and Unmaking of Ignorance*. Stanford, CA: Stanford University Press.
- Rasli, Amran M., Muhammad Imran Qureshi, Aliyu Isah-Chikaji, Khalid Zaman, and Mehboob Ahmad. 2018. "New Toxics, Race to the Bottom and Revised Environmental Kuznets Curve: The Case of Local and Global Pollutants." *Renewable and Sustainable Energy Reviews* 81: 3120–3130. doi:10.1016/j.rser.2017.08.092.
- Rich, Nathaniel. 2016. "The Lawyer Who Became DuPont's Worst Nightmare." *New York Times*, 6 January. <https://www.nytimes.com/interactive/2020/admin/100000004126761.embedded.html?>
- Rockström, Johan, Will Steffen, Kevin Noone, Asa Persson, F. Stuart Chapin, Eric F. Lambin, . . . , Timothy M. Lenton. 2009. "A Safe Operating Space for Humanity." *Nature* 461 (7263): 472–475. doi:10.1038/461472a.
- Rosen, Ellen Israel. 2005. "The Wal-Mart Effect: The World Trade Organization and the Race to the Bottom International Law Symposium." *Chapman Law Review* 8: 261–282. [https://www.chapman.edu/law/\\_files/publications/CLR-8-ellen-israel-rosen.pdf](https://www.chapman.edu/law/_files/publications/CLR-8-ellen-israel-rosen.pdf).
- Roustan, A., M. Aye, M. De Meo, and C. Di Giorgio. 2014. "Genotoxicity of Mixtures of Glyphosate and Atrazine and Their Environmental Transformation Products before and after Photoactivation." *Chemosphere* 108: 93–100. doi:10.1016/j.chemosphere.2014.02.079.
- Santos, Boaventura de Sousa. 2016. *Epistemologies of the South: Justice against Epistemicide*. London: Routledge.
- Serres, Michel. 2010. *Malfesance: Appropriation through Pollution?* Trans. Anne-Marie Feenberg-Dibon. Stanford, CA: Stanford University Press.
- Shaw, Susan. 2010. "Halogenated Flame Retardants: Do the Fire Safety Benefits Justify the Risks?" *Reviews on Environmental Health* 25 (4): 261–306. doi:10.1515/REVEH.2010.25.4.261.
- Sier, Jessica. 2020. Bayer Shares Climb after \$11B Roundup Settlement." *Marketwatch.com*, 25 June. <https://www.marketwatch.com/story/bayer-shares-climb-after-11b-roundup-settlement-2020-06-25>.
- Soechtig, Stephanie, and Jeremy Seifert. 2019. *The Devil We Know*. Atlas Films. USA. <http://www.imdb.com/title/tt7689910/>.

- Solomon, Sheldon, Jeff Greenberg, and Thomas A. Pyszczynski. 2015. *The Worm at the Core: On the Role of Death in Life*. New York: Random House.
- Standing Committee on Emerging Science for Environmental Health Decisions, Board on Life Sciences, Board on Environmental Studies and Toxicology, Division on Earth and Life Studies, and National Academies of Sciences, Engineering, and Medicine. 2018. *Understanding Pathways to a Paradigm Shift in Toxicity Testing and Decision-Making: Proceedings of a Workshop in Brief*. Ed. Julie Fitzpatrick. Washington, DC: National Academies Press. doi:10.17226/25135.
- Sullivan, Shannon, and Nancy Tuana, eds. 2007. *Race and Epistemologies of Ignorance*. Albany: State University of New York Press.
- Szasz, Andrew. 2007. *Shopping Our Way to Safety: How We Changed from Protecting the Environment to Protecting Ourselves*. Minneapolis: University of Minnesota Press.
- Taylor, Charles. 2004. *Modern Social Imaginaries*. Durham, NC: Duke University Press.
- Taylor, Christopher T. 2004. "The Economic Effects of Withdrawn Antidumping Investigations: Is There Evidence of Collusive Settlements?" *Journal of International Economics* 62 (2): 295–312. doi:10.1016/S0022-1996(03)00051-5.
- Toepel, Ana. 2019. "UCSF Sustainability." UCSF Office of Sustainability. June 2019. <https://sustainability.ucsf.edu/3.782>.
- Toscano, Nick, and Mike Foley. 2020. "Global GDP to Fall 25 per Cent without More Climate Action, Banks Warn." *Sydney Morning Herald*, 25 June. <https://www.smh.com.au/politics/federal/global-gdp-to-fall-25-per-cent-without-more-climate-action-banks-warn-20200625-p5563t.html>.
- Udall, Tom, and Alan Lowenthal. 2020. "Op-Ed: More than 90 percent of U.S. Plastic Waste Is Never Recycled. Here's How We Can Change That." *Los Angeles Times* 21 February. 2020. <https://www.latimes.com/opinion/story/2020-02-21/plastic-waste-never-recycled-u-s>.
- UN News. 2020. "COVID-19 Environmental Roll Back 'Irrational and Irresponsible': Rights Expert." *United Nations News*, 15 April. <https://news.un.org/en/story/2020/04/1061772>.
- US Environmental Protection Agency. 2020. "EPA Announces New Tool for Soybean Growers to Combat Weeds." *Speeches, Testimony and Transcripts, Chemical Safety and Pollution Prevention (OCSPP)*, 30 March. <https://www.epa.gov/newsreleases/epa-announces-new-tool-soybean-growers-combat-weeds>.
- Valles, Sean A. 2018. *Philosophy of Population Health: Philosophy for a New Public Health Era*. London: Routledge.
- Vane C. H., S. R. Chenery, I. Harrison, A. W. Kim, V. Moss-Hayes, and D. G. Jones. 2011. "Chemical Signatures of the Anthropocene in the Clyde Estuary, UK: Sediment-Hosted Pb, 207/206Pb, Total Petroleum Hydrocarbon, Polyaromatic Hydrocarbon and Polychlorinated Biphenyl Pollution Records." *Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences* 369 (1938): 1085–1111. doi:10.1098/rsta.2010.0298.
- Vaughan, Steven. 2015. *EU Chemicals Regulation: New Governance, Hybridity and REACH*. Cheltenham, UK: Edward Elgar Publishing.
- Vijver, Martina G., Ellard R. Hunting, Tom A. P. Nederstigt, Wil L. M. Tamis, Paul J. van den Brink, and Peter M. van Bodegom. 2017. "Postregistration Monitoring of Pesticides Is Urgently Required to Protect Ecosystems." *Environmental Toxicology and Chemistry* 36 (4): 860–865. doi:10.1002/etc.3721.
- Wagner, Wendy. 2008. "Using Competition-Based Regulation to Bridge the Toxics Data Gap." *Indiana Law Journal* 83 (2). <https://www.repository.law.indiana.edu/ilj/vol83/iss2/8>.
- Waters, Colin N., Jan Zalasiewicz, Colin Summerhayes, Anthony D. Barnosky, Clément Poirier, Agnieszka Gajuszka, . . . , and Alejandro Cearreta. 2016. "The Anthropocene Is Functionally and Stratigraphically Distinct from the Holocene." *Science* 351 (6269). doi:10.1126/science.aad2622.
- Wisner, R. Brent. 2018. "Bayer CEO Open to Roundup Settlements Following Verdict and Stock Hit." *Baum Hedlund*, November. <https://www.baumhedlundlaw.com/11-18-bayer-monsanto-roundup-settlement/>.
- Woodruff, Tracey J., Ami R. Zota, and Jackie M. Schwartz. 2011. "Environmental Chemicals in Pregnant Women in the United States: NHANES 2003–2004." *Environmental Health Perspectives* 119 (6): 878–885. doi:10.1289/ehp.1002727.

- Zhao, Huiyu, and Robert Percival. 2017. "Comparative Environmental Federalism: Subsidiarity and Central Regulation in the United States and China." *Transnational Environmental Law* 6 (3): 531–549. doi:10.1017/S2047102517000206.
- Zota, Ami R., Ruth J. Geller, Antonia M. Calafat, Cherie Q. Marfori, Andrea A. Baccarelli, and Gaby N. Moawad. 2019. "Phthalates Exposure and Uterine Fibroid Burden among Women Undergoing Surgical Treatment for Fibroids: A Preliminary Study." *Fertility and Sterility* 111 (1): 112–121. doi:10.1016/j.fertnstert.2018.09.009.