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A VALUABLE REPUTATION

After Tyrone Hayes said that a chemical was harmful, its maker pursued him.

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Hayes has devoted the past fifteen years to studying atrazine, a widely used herbicide made by Syngenta. The company's notes reveal that it struggled to make sense of him, and plotted ways to discredit him. Photograph by Dan

Winters.

In 2001, seven years after joining the biology faculty of the University of California, Berkeley, Tyrone Hayes stopped talking about his research with people he didn't trust. He instructed the students in his lab, where he was raising three thousand frogs, to hang up the phone if they heard a click, a signal that a third party might be on the line. Other scientists seemed to remember events differently, he noticed, so he started carrying an audio recorder to meetings. "The secret to a happy, successful life of paranoia," he liked to say, "is to keep careful track of your persecutors."

Three years earlier, Syngenta, one of the largest agribusinesses in the world, had asked Hayes to conduct experiments on the herbicide atrazine, which is applied to more than half the corn in the United States. Hayes was thirty-one, and he had already published twenty papers on the endocrinology of amphibians. David Wake, a professor in Hayes's department, said that Hayes "may have had the greatest potential of anyone in the field." But, when Hayes discovered that atrazine might impede the sexual development of frogs, his dealings with Syngenta became strained, and, in November, 2000, he ended his relationship with the company.

Hayes continued studying atrazine on his own, and soon he became convinced that Syngenta representatives were following him to conferences around the world. He worried that the company was orchestrating a campaign to destroy his reputation. He complained that whenever he gave public talks there was a stranger in the back of the room, taking notes. On a trip to Washington, D.C., in 2003, he stayed at a different hotel each night. He was still in touch with a few Syngenta scientists and, after noticing that they knew many details about his work and his schedule, he suspected that they were reading his e-mails. To confuse them, he asked a student to write misleading e-mails from his office computer while he was travelling. He sent backup copies of his data and notes to his parents in sealed boxes. In an e-mail to one Syngenta scientist, he wrote that he had "risked my reputation, my name . . . some say even my life, for what I thought (and now know) is right." A few scientists had previously done experiments that anticipated Hayes's work, but no one had observed such extreme effects. In another e-mail to Syngenta, he acknowledged that it might appear that he was suffering from a "Napoleon complex" or "delusions of grandeur."

For years, despite his achievements, Hayes had felt like an interloper. In academic settings, it seemed to him that his colleagues were operating according to a frivolous code of manners: they spoke so formally, fashioning themselves as detached authorities, and rarely admitted what they didn't know. He had grown up in Columbia, South Carolina, in a neighborhood where fewer than forty per cent of residents finish high school. Until sixth grade, when he was

accepted into a program for the gifted, in a different neighborhood, he had never had a conversation with a white person his age. He and his friends used to tell one another how “white people do this, and white people do that,” pretending that they knew. After he switched schools and took advanced courses, the black kids made fun of him, saying, “Oh, he thinks he’s white.”

He was fascinated by the idea of metamorphosis, and spent much of his adolescence collecting tadpoles and frogs and crossbreeding different species of grasshoppers. He raised frog larvae on his parents’ front porch, and examined how lizards respond to changes in temperature (by using a blow-dryer) and light (by placing them in a doghouse). His father, a carpet layer, used to look at his experiments, shake his head, and say, “There’s a fine line between a genius and a fool.”

Hayes received a scholarship to Harvard, and, in 1985, began what he calls the worst four years of his life. Many of the other black students had gone to private schools and came from affluent families. He felt disconnected and ill-equipped—he was placed on academic probation—until he became close to a biology professor, who encouraged him to work in his lab. Five feet three and thin, Hayes distinguished himself by dressing flamboyantly, like Prince. The *Harvard Crimson*, in an article about a campus party, wrote that he looked as if he belonged in the “rock-’n’-ready atmosphere of New York’s Danceteria.” He thought about dropping out, but then he started dating a classmate, Katherine Kim, a Korean-American biology major from Kansas. He married her two days after he graduated.

They moved to Berkeley, where Hayes enrolled in the university’s program in integrative biology. He completed his Ph.D. in three and a half years, and was immediately hired by his department. “He was a force of nature—incredibly gifted and hardworking,” Paul Barber, a colleague who is now a professor at U.C.L.A., says. Hayes became one of only a few black tenured biology professors in the country. He won Berkeley’s highest award for teaching, and ran the most racially diverse lab in his department, attracting students who were the first in their families to go to college. Nigel Noriega, a former graduate student, said that the lab was a “comfort zone” for students who were “just suffocating at Berkeley,” because they felt alienated from academic culture.

Hayes had become accustomed to steady praise from his colleagues, but, when Syngenta cast doubt on his work, he became preoccupied by old anxieties. He believed that the company was trying to isolate him from other scientists and “play on my insecurities—the fear that I’m not good enough, that everyone thinks I’m a fraud,” he said. He told colleagues that he suspected that Syngenta held “focus groups” on how to mine his vulnerabilities. Roger Liu, who worked in Hayes’s lab for a decade, both as an undergraduate and as a graduate student, said, “In the beginning, I was really worried for his safety. But then I couldn’t tell where the reality

ended and the exaggeration crept in.”

Liu and several other former students said that they had remained skeptical of Hayes’s accusations until last summer, when an article appeared in *Environmental Health News* (in partnership with *100Reporters*)* that drew on Syngenta’s internal records. Hundreds of Syngenta’s memos, notes, and e-mails have been unsealed following the settlement, in 2012, of two class-action suits brought by twenty-three Midwestern cities and towns that accused Syngenta of “concealing atrazine’s true dangerous nature” and contaminating their drinking water. Stephen Tillery, the lawyer who argued the cases, said, “Tyrone’s work gave us the scientific basis for the lawsuit.”

Hayes has devoted the past fifteen years to studying atrazine, and during that time scientists around the world have expanded on his findings, suggesting that the herbicide is associated with birth defects in humans as well as in animals. The company documents show that, while Hayes was studying atrazine, Syngenta was studying him, as he had long suspected. Syngenta’s public-relations team had drafted a list of four goals. The first was “discredit Hayes.” In a spiral-bound notebook, Syngenta’s communications manager, Sherry Ford, who referred to Hayes by his initials, wrote that the company could “prevent citing of TH data by revealing him as noncredible.” He was a frequent topic of conversation at company meetings. Syngenta looked for ways to “exploit Hayes’ faults/problems.” “If TH involved in scandal, enviros will drop him,” Ford wrote. She observed that Hayes “grew up in world (S.C.) that wouldn’t accept him,” “needs adulation,” “doesn’t sleep,” was “scarred for life.” She wrote, “What’s motivating Hayes?—basic question.”

S yngenta, which is based in Basel, sells more than fourteen billion dollars’ worth of seeds and pesticides a year and funds research at some four hundred academic institutions around the world. When Hayes agreed to do experiments for the company (which at that time was part of a larger corporation, Novartis), the students in his lab expressed concern that biotech companies were “buying up universities” and that industry funding would compromise the objectivity of their research. Hayes assured them that his fee, a hundred and twenty-five thousand dollars, would make their lab more rigorous. He could employ more students, buy new equipment, and raise more frogs. Though his lab was well funded, federal support for research was growing increasingly unstable, and, like many academics and administrators, he felt that he should find new sources of revenue. “I went into it as if I were a painter, performing a service,” Hayes told me. “You commissioned it, and I come up with the results, and you do what you want with them. It’s your responsibility, not mine.”

Atrazine is the second most widely used herbicide in the U.S., where sales are estimated at

about three hundred million dollars a year. Introduced in 1958, it is cheap to produce and controls a broad range of weeds. (Glyphosate, which is produced by Monsanto, is the most popular herbicide.) A study by the Environmental Protection Agency found that without atrazine the national corn yield would fall by six per cent, creating an annual loss of nearly two billion dollars. But the herbicide degrades slowly in soil and often washes into streams and lakes, where it doesn't readily dissolve. Atrazine is one of the most common contaminants of drinking water; an estimated thirty million Americans are exposed to trace amounts of the chemical.

In 1994, the E.P.A., expressing concerns about atrazine's health effects, announced that it would start a scientific review. Syngenta assembled a panel of scientists and professors, through a consulting firm called EcoRisk, to study the herbicide. Hayes eventually joined the group. His first experiment showed that male tadpoles exposed to atrazine developed less muscle surrounding their vocal cords, and he hypothesized that the chemical had the potential to reduce testosterone levels. "I have been losing lots of sleep over this," he wrote one EcoRisk panel member, in the summer of 2000. "I realize the implications and of course want to make sure that everything possible has been done and controlled for." After a conference call, he was surprised by the way the company kept critiquing what seemed to be trivial aspects of the work. Hayes wanted to repeat and validate his experiments, and complained that the company was slowing him down and that independent scientists would publish similar results before he could. He decided to resign from the panel, writing in a letter that he didn't want to be "scooped." "I fear that my reputation will be damaged if I continue my relationship and associated low productivity with Novartis," he wrote. "It will appear to my colleagues that I have been part of a plan to bury important data."

Hayes repeated the experiments using funds from Berkeley and the National Science Foundation. Afterward, he wrote to the panel, "Although I do not want to make a big deal out of it until I have all of the data analyzed and decoded—I feel I should warn you that I think something very strange is coming up in these animals." After dissecting the frogs, he noticed that some could not be clearly identified as male or female: they had both testes and ovaries. Others had multiple testes that were deformed.

In January, 2001, Syngenta employees and members of the EcoRisk panel travelled to Berkeley to discuss Hayes's new findings. Syngenta asked to meet with him privately, but Hayes insisted on the presence of his students, a few colleagues, and his wife. He had previously had an amiable relationship with the panel—he had enjoyed taking long runs with the scientist who supervised it—and he began the meeting, in a large room at Berkeley's Museum of Vertebrate Zoology, as if he were hosting an academic conference. He wore a new

suit and brought in catered meals.

After lunch, Syngenta introduced a guest speaker, a statistical consultant, who listed numerous errors in Hayes's report and concluded that the results were not statistically significant. Hayes's wife, Katherine Kim, said that the consultant seemed to be trying to "make Tyrone look as foolish as possible." Wake, the biology professor, said that the men on the EcoRisk panel looked increasingly uncomfortable. "They were experienced enough to know that the issues the statistical consultant was raising were routine and ridiculous," he said. "A couple of glitches were presented as if they were the end of the world. I've been a scientist in academic settings for forty years, and I've never experienced anything like that. They were after Tyrone."

Hayes later e-mailed three of the scientists, telling them, "I was insulted, felt railroaded and, in fact, felt that some dishonest and unethical activity was going on." When he explained what had happened to Theo Colborn, the scientist who had popularized the theory that industrial chemicals could alter hormones, she advised him, "Don't go home the same way twice." Colborn was convinced that her office had been bugged, and that industry representatives followed her. She told Hayes to "keep looking over your shoulder" and to be careful whom he let in his lab. She warned him, "You have got to protect yourself."

Hayes published his atrazine work in the *Proceedings of the National Academy of Sciences* a year and a half after quitting the panel. He wrote that what he called "hermaphroditism" was induced in frogs by exposure to atrazine at levels thirty times below what the E.P.A. permits in water. He hypothesized that the chemical could be a factor in the decline in amphibian populations, a phenomenon observed all over the world. In an e-mail sent the day before the publication, he congratulated the students in his lab for taking the "ethical stance" by continuing the work on their own. "We (and our principles) have been tested, and I believe we have not only passed but exceeded expectations," he wrote. "Science is a principle and a process of seeking truth. Truth cannot be purchased and, thus, truth cannot be altered by money. Professorship is not a career, but rather a life's pursuit. The people with whom I work daily exemplify and remind me of this promise."

He and his students continued the work, travelling to farming regions throughout the Midwest, collecting frogs in ponds and lakes, and sending three hundred pails of frozen water back to Berkeley. In papers in *Nature* and in *Environmental Health Perspectives*, Hayes reported that he had found frogs with sexual abnormalities in atrazine-contaminated sites in Illinois, Iowa, Nebraska, and Wyoming. "Now that I have realized what we are into, I cannot stop it," he wrote to a colleague. "It is an entity of its own." Hayes began arriving at his lab at

3:30 A.M. and staying fourteen hours. He had two young children, who sometimes assisted by color-coding containers.

According to company e-mails, Syngenta was distressed by Hayes's work. Its public-relations team compiled a database of more than a hundred "supportive third party stakeholders," including twenty-five professors, who could defend atrazine or act as "spokespeople on Hayes." The P.R. team suggested that the company "purchase 'Tyrone Hayes' as a search word on the internet, so that any time someone searches for Tyrone's material, the first thing they see is our material." The proposal was later expanded to include the phrases "amphibian hayes," "atrazine frogs," and "frog feminization." (Searching online for "Tyrone Hayes" now brings up an advertisement that says, "Tyrone Hayes Not Credible.")

In June, 2002, two months after Hayes's first atrazine publication, Syngenta announced in a press release that three studies had failed to replicate Hayes's work. In a letter to the editor of the *Proceedings of the National Academy of Sciences*, eight scientists on the EcoRisk panel wrote that Hayes's study had "little regard for assessment of causality," lacked statistical details, misused the term "dose," made vague and naïve references, and misspelled a word. They said that Hayes's claim that his paper had "significant implications for environmental and public health" had not been "scientifically demonstrated." Steven Milloy, a freelance science columnist who runs a nonprofit organization to which Syngenta has given tens of thousands of dollars, wrote an article for Fox News titled "Freaky-Frog Fraud," which picked apart Hayes's paper in *Nature*, saying that there wasn't a clear relationship between the concentration of atrazine and the effect on the frog. Milloy characterized Hayes as a "junk scientist" and dismissed his "lame" conclusions as "just another of Hayes' tricks."

Fussy critiques of scientific experiments have become integral to what is known as the "sound science" campaign, an effort by interest groups and industries to slow the pace of regulation. David Michaels, the Assistant Secretary of Labor for Occupational Safety and Health, wrote, in his book "Doubt Is Their Product" (2008), that corporations have developed sophisticated strategies for "manufacturing and magnifying uncertainty." In the eighties and nineties, the tobacco industry fended off regulations by drawing attention to questions about the science of secondhand smoke. Many companies have adopted this tactic. "Industry has learned that debating the *science* is much easier and more effective than debating the *policy*," Michaels wrote. "In field after field, year after year, conclusions that might support regulation are always disputed. Animal data are deemed not relevant, human data not representative, and exposure data not reliable."

In the summer of 2002, two scientists from the E.P.A. visited Hayes's lab and reviewed his

atrazine data. Thomas Steeger, one of the scientists, told Hayes, “Your research can potentially affect the balance of risk versus benefit for one of the most controversial pesticides in the U.S.” But an organization called the Center for Regulatory Effectiveness petitioned the E.P.A. to ignore Hayes’s findings. “Hayes has killed and continues to kill thousands of frogs in unvalidated tests that have no proven value,” the petition said. The center argued that Hayes’s studies violated the Data Quality Act, passed in 2000, which requires that regulatory decisions rely on studies that meet high standards for “quality, objectivity, utility, and integrity.” The center is run by an industry lobbyist and consultant for Syngenta, Jim Tozzi, who proposed the language of the Data Quality Act to the congresswoman who sponsored it.

The E.P.A. complied with the Data Quality Act and revised its Environmental Risk Assessment, making it clear that hormone disruption wouldn’t be a legitimate reason for restricting use of the chemical until “appropriate testing protocols have been established.” Steeger told Hayes that he was troubled by the circularity of the center’s critique. In an e-mail, he wrote, “Their position reminds me of the argument put forward by the philosopher Berkeley, who argued against empiricism by noting that reliance on scientific observation is flawed since the link between observations and conclusions is intangible and is thus immeasurable.”

Nonetheless, Steeger seemed resigned to the frustrations of regulatory science and gently punctured Hayes’s idealism. When Hayes complained that Syngenta had not reported his findings on frog hermaphroditism quickly enough, he responded that it was “unfortunate but not uncommon for registrants to ‘sit’ on data that may be considered adverse to the public’s perception of their products.” He wrote that “science can be manipulated to serve certain agendas. All you can do is practice ‘suspended disbelief.’ ” (The E.P.A. says that there is “no indication that information was improperly withheld in this case.”)

After consulting with colleagues at Berkeley, Hayes decided that, rather than watch Syngenta discredit his work, he would make a “preemptive move.” He appeared in features in *Discover* and the San Francisco *Chronicle*, suggesting that Syngenta’s science was not objective. Both articles focussed on his personal biography, leading with his skin color, and moving on to his hair style: at the time, he wore his hair in braids. Hayes made little attempt to appear disinterested. Scientific objectivity requires what the philosopher Thomas Nagel has called a “view from nowhere,” but Hayes kept drawing attention to himself, making blustery comments like “Tyrone can only be Tyrone.” He presented Syngenta as a villain, but he didn’t quite fulfill the role of the hero. He was hyper and a little frantic—he always seemed to be in a rush or on the verge of forgetting to do something—and he approached the idea of taking down the big guys with a kind of juvenile zeal.

Environmental activists praised Hayes’s work and helped him get media attention. But they

were concerned by the bluntness of his approach. A co-founder of the Environmental Working Group, a nonprofit research organization, told Hayes to “stop what you are doing and take time to actually construct a plan” or “you will get your ass handed to you on a platter.” Steeger warned him that vigilantism would distract him from his research. “Can you afford the time and money to fight battles where you are clearly outnumbered and, to be candid, outclassed?” he asked. “Most people would prefer to limit their time in purgatory; I don’t know anyone who knowingly enters hell.”

Hayes had worked all his life to build his scientific reputation, and now it seemed on the verge of collapse. “I cannot in reasonable terms explain to you what this means to me,” he told Steeger. He took pains to prove that Syngenta’s experiments had not replicated his studies: they used a different population of animals, which were raised in different types of tanks, in closer quarters, at cooler temperatures, and with a different feeding schedule. On at least three occasions, he proposed to the Syngenta scientists that they trade data. “If we really want to test repeatability, let’s share animals and solutions,” he wrote.

In early 2003, Hayes was considered for a job at the Nicholas School of the Environment, at Duke. He visited the campus three times, and the university arranged for a real-estate agent to show him and his wife potential homes. When Syngenta learned that Hayes might be moving to North Carolina, where its crop-protection headquarters are situated, Gary Dickson—the company’s vice-president of global risk assessment, who a year earlier had established a fifty-thousand-dollar endowment, funded by Syngenta, at the Nicholas School—contacted a dean at Duke. According to documents unsealed in the class-action lawsuits, Dickson informed the dean of the “state of the relationship between Dr. Hayes and Syngenta.” The company “wanted to protect our reputation in our community and among our employees.”

There were several candidates for the job at Duke, and, when Hayes did not get it, he concluded that it was due to Syngenta’s influence. Richard Di Giulio, a Duke professor who had hosted Hayes’s first visit, said that he was irritated by Hayes’s suggestion: “A little gift of fifty thousand dollars would not influence a tenure hire. That’s not going to happen.” He added, “I’m not surprised that Syngenta would not have liked Hayes to be at Duke, since we’re an hour down the road from them.” He said that Hayes’s conflict with Syngenta was an extreme example of the kind of dispute that is not uncommon in environmental science. The difference, he said, was that the “scientific debate spilled into Hayes’s emotional life.”

In June, 2003, Hayes paid his own way to Washington so that he could present his work at an E.P.A. hearing on atrazine. The agency had evaluated seventeen studies. Twelve experiments had been funded by Syngenta, and all but two showed that atrazine had no effect on the sexual

development of frogs. The rest of the experiments, by Hayes and researchers at two other universities, indicated the opposite. In a PowerPoint presentation at the hearing, Hayes disclosed a private e-mail sent to him by one of the scientists on the EcoRisk panel, a professor at Texas Tech, who wrote, “I agree with you that the important issue is for everyone involved to come to grips with (and stop minimizing) the fact that independent laboratories have demonstrated an effect of atrazine on gonadal differentiation in frogs. There is no denying this.”

The E.P.A. found that all seventeen atrazine studies, including Hayes’s, suffered from methodological flaws—contamination of controls, variability in measurement end points, poor animal husbandry—and asked Syngenta to fund a comprehensive experiment that would produce more definitive results. Darcy Kelley, a member of the E.P.A.’s scientific advisory panel and a biology professor at Columbia, said that, at the time, “I did not think the E.P.A. made the right decision.” The studies by Syngenta scientists had flaws that “really cast into doubt their ability to carry out their experiments. They couldn’t replicate effects that are as easy as falling off a log.” She thought that Hayes’s experiments were more respectable, but she wasn’t persuaded by Hayes’s explanation of the biological mechanism causing the deformities.

The E.P.A. approved the continued use of atrazine in October, the same month that the European Commission chose to remove it from the market. The European Union generally takes a precautionary approach to environmental risks, choosing restraint in the face of uncertainty. In the U.S., lingering scientific questions justify delays in regulatory decisions. Since the mid-seventies, the E.P.A. has issued regulations restricting the use of only five industrial chemicals out of more than eighty thousand in the environment. Industries have a greater role in the American regulatory process—they may sue regulators if there are errors in the scientific record—and cost-benefit analyses are integral to decisions: a monetary value is assigned to disease, impairments, and shortened lives and weighed against the benefits of keeping a chemical in use. Lisa Heinzerling, the senior climate-policy counsel at the E.P.A. in 2009 and the associate administrator of the office of policy in 2009 and 2010, said that cost-benefit models appear “objective and neutral, a way to free ourselves from the chaos of politics.” But the complex algorithms “quietly condone a tremendous amount of risk.” She added that the influence of the Office of Management and Budget, which oversees major regulatory decisions, has deepened in recent years. “A rule will go through years of scientific reviews and cost-benefit analyses, and then at the final stage it doesn’t pass,” she said. “It has a terrible, demoralizing effect on the culture at the E.P.A.”

In 2003, a Syngenta development committee in Basel approved a strategy to keep atrazine on the market “until at least 2010.” A PowerPoint presentation assembled by Syngenta’s global

product manager explained that “we need atrazine to secure our position in the corn marketplace. Without atrazine we cannot defend and grow our business in the USA.” Sherry Ford, the communications manager, wrote in her notebook that the company “should not phase out atz until we know about” the Syngenta herbicide paraquat, which has also been controversial, because of studies showing that it might be associated with Parkinson’s disease. She noted that atrazine “focuses attention away from other products.”

Syngenta began holding weekly “atrazine meetings” after the first class-action suit was filed, in 2004. The meetings were attended by toxicologists, the company’s counsel, communications staff, and the head of regulatory affairs. To dampen negative publicity from the lawsuit, the group discussed how it could invalidate Hayes’s research. Ford documented peculiar things he had done (“kept coat on”) or phrases he had used (“Is this line clean?”). “If TH wanted to win the day, and he had the goods,” she wrote, “he would have produced them when asked.” She noted that Hayes was “getting in too deep w/ enviros,” and searched for ways to get him to “show his true colors.”

In 2005, Ford made a long list of methods for discrediting him: “have his work audited by 3rd party,” “ask journals to retract,” “set trap to entice him to sue,” “investigate funding,” “investigate wife.” The initials of different employees were written in the margins beside entries, presumably because they had been assigned to look into the task. Another set of ideas, discussed at several meetings, was to conduct “systematic rebuttals of all TH appearances.” One of the company’s communications consultants said in an e-mail that she wanted to obtain Hayes’s calendar of speaking engagements, so that Syngenta could “start reaching out to the potential audiences with the Error vs. Truth Sheet,” which would provide “irrefutable evidence of his polluted messages.” (Syngenta says that many of the documents unsealed in the lawsuits refer to ideas that were never implemented.)

To redirect attention to the financial benefits of atrazine, the company paid Don Coursey, a tenured economist at the Harris School of Public Policy, at the University of Chicago, five hundred dollars an hour to study how a ban on the herbicide would affect the economy. In 2006, Syngenta supplied Coursey with data and a “bundle of studies,” and edited his paper, which was labelled as a Harris School Working Paper. (He disclosed that Syngenta had funded it.) After submitting a draft, Coursey had been warned in an e-mail that he needed to work harder to articulate a “clear statement of your conclusions flowing from this analysis.” Coursey later announced his findings at a National Press Club event in Washington and told the audience that there was one “basic takeaway point: a ban on atrazine at the national level will have a devastating, devastating effect upon the U.S. corn economy.”

Hayes had been promoted from associate to full professor in 2003, an achievement that had sent him into a mild depression. He had spent the previous decade understanding his self-worth in reference to a series of academic milestones, and he had reached each one. Now he felt aimless. His wife said she could have seen him settling into the life of a “normal, run-of-the-mill, successful scientist.” But he wasn’t motivated by the idea of “writing papers and books that we all just trade with each other.”

He began giving more than fifty lectures a year, not just to scientific audiences but to policy institutes, history departments, women’s health clinics, food preparers, farmers, and high schools. He almost never declined an invitation, despite the distance. He told his audiences that he was defying the instructions of his Ph.D. adviser, who had told him, “Let the science speak for itself.” He had a flair for sensational stories—he chose phrases like “crime scene” and “chemically castrated”—and he seemed to revel in details about Syngenta’s conflicts of interest, presenting theories as if he were relating gossip to friends. (Syngenta wrote a letter to Hayes and his dean, pointing out inaccuracies: “As we discover additional errors in your presentations, you can expect us to be in touch with you again.”)

At his talks, Hayes noticed that one or two men in the audience were dressed more sharply than the other scientists. They asked questions that seemed to have been designed to embarrass him: Why can’t anyone replicate your research? Why won’t you share your data? One former student, Ali Stuart, said that “everywhere Tyrone went there was this guy asking questions that made a mockery of him. We called him the Axe Man.”

Hayes had once considered a few of the scientists working with Syngenta friends, and he approached them in a nerdy style of defiance. He wrote them mass e-mails, informing them of presentations he was giving and offering tips on how to discredit him. “You can’t approach your prey thinking like a predator,” he wrote. “You have to become your quarry.” He described a recent trip to South Carolina and his sense of displacement when “my old childhood friend came by to update me on who got killed, who’s on crack, who went to jail.” He wrote, “I have learned to talk like you (better than you . . . by your own admission), write like you (again better) . . . you however don’t know anyone like me . . . you have yet to spend a day in my world.” After seeing an e-mail in which a lobbyist characterized him as “black and quite articulate,” he began signing his e-mails, “Tyrone B. Hayes, Ph.D., A.B.M.,” for “articulate black man.”

Syngenta was concerned by Hayes’s e-mails and commissioned an outside contractor to do a “psychological profile” of Hayes. In her notes, Sherry Ford described him as “bipolar/manic-depressive” and “paranoid schizo & narcissistic.” Roger Liu, Hayes’s student, said that he

thought Hayes wrote the e-mails to relieve his anxiety. Hayes often showed the e-mails to his students, who appreciated his rebellious sense of humor. Liu said, “Tyrone had all these groupies in the lab cheering him on. I was the one in the background saying, you know, ‘Man, don’t egg them on. Don’t poke that beast.’ ”

S yngenta intensified its public-relations campaign in 2009, as it became concerned that activists, touting “new science,” had developed a “new line of attack.” That year, a paper in *Acta Paediatrica*, reviewing national records for thirty million births, found that children conceived between April and July, when the concentration of atrazine (mixed with other pesticides) in water is highest, were more likely to have genital birth defects. The author of the paper, Paul Winchester, a professor of pediatrics at the Indiana University School of Medicine, received a subpoena from Syngenta, which requested that he turn over every e-mail he had written about atrazine in the past decade. The company’s media talking points described his study as “so-called science” that didn’t meet the “guffaw test.” Winchester said, “We don’t have to argue that I haven’t proved the point. Of course I haven’t proved the point! Epidemiologists don’t try to prove points—they look for problems.”

A few months after Winchester’s paper appeared, the *Times* published an investigation suggesting that atrazine levels frequently surpass the maximum threshold allowed in drinking water. The article referred to recent studies in *Environmental Health Perspectives* and the *Journal of Pediatric Surgery* that found that mothers living close to water sources containing atrazine were more likely to have babies who were underweight or had a defect in which the intestines and other organs protrude from the body.

The day the article appeared, Syngenta planned to “go through the article line by line and find all 1) inaccuracies and 2) misrepresentations. Turn that into a simple chart.” The company would have “a credible third party do the same.” Elizabeth Whelan, the president of the American Council on Science and Health, which asked Syngenta for a hundred thousand dollars that year, appeared on MSNBC and declared that the *Times* article was not based on science. “I’m a public-health professional,” she said. “It really bothers me very much to see the New York *Times* front-page Sunday edition featuring an article about a bogus risk.”

Syngenta’s public-relations team wrote editorials about the benefits of atrazine and about the flimsy science of its critics, and then sent them to “third-party allies,” who agreed to “byline” the articles, which appeared in the *Washington Times*, the *Rochester Post-Bulletin*, the *Des Moines Register*, and the *St. Cloud Times*. When a few articles in the “op-ed pipeline” sounded too aggressive, a Syngenta consultant warned that “some of the language of these pieces is suggestive of their source, which suggestion should be avoided at all costs.”

After the *Times* article, Syngenta hired a communications consultancy, the White House Writers Group, which has represented more than sixty Fortune 500 companies. In an e-mail to Syngenta, Josh Gilder, a director of the firm and a former speechwriter for Ronald Reagan, wrote, “We need to start fighting our own war.” By warning that a ban on atrazine would “devastate the economies” of rural regions, the firm tried to create a “state of affairs in which the new political leadership at E.P.A. finds itself increasingly isolated.” The firm held “elite dinners with Washington influentials” and tried to “prompt members of Congress” to challenge the scientific rationale for an upcoming E.P.A. review of atrazine. In a memo describing its strategy, the White House Writers Group wrote that, “regarding science, it is important to keep in mind that the major players in Washington do not understand science.”

In 2010, Hayes told the EcoRisk panel in an e-mail, “I have just initiated what will be the most extraordinary academic event in this battle!” He had another paper coming out in the *Proceedings of the National Academy of Sciences*, which described how male tadpoles exposed to atrazine grew up to be functional females with impaired fertility. He advised the company that it would want to get its P.R. campaign up to speed. “It’s nice to know that in this economy I can keep so many people employed,” he wrote. He quoted both Tupac Shakur and the South African king Shaka Zulu: “Never leave an enemy behind or it will rise again to fly at your throat.”

Syngenta’s head of global product safety wrote a letter to the editor of the *Proceedings of the National Academy of Sciences* and to the president of the National Academy of Sciences, expressing concern that a “publication with so many obvious weaknesses could achieve publication in such a reputable scientific journal.” A month later, Syngenta filed an ethics complaint with the chancellor of Berkeley, claiming that Hayes’s e-mails violated the university’s Standards of Ethical Conduct, particularly Respect for Others. Syngenta posted more than eighty of Hayes’s e-mails on its Web site and enclosed a few in its letter to the chancellor. In one, with the subject line “Are y’all ready for it,” Hayes wrote, “Ya fulla my j*z right now!” In another, he told the Syngenta scientists that he’d had a drink after a conference with their “republican buddies,” who wanted to know about a figure he had used in his paper. “As long as you followin me around, I know I’m da sh*t,” he wrote. “By the way, yo boy left his pre-written questions at the table!”

Berkeley declined to take disciplinary action against Hayes. The university’s lawyer reminded Syngenta in a letter that “all parties have an equal responsibility to act professionally.” David Wake said that he read many of the e-mails and found them “quite hilarious.” “He’s treating them like street punks, and they view themselves as captains of industry,” he said.

“When he gets tapped, he goes right back at them.”

Michelle Boone, a professor of aquatic ecology at Miami University, who served on the E.P.A.’s scientific advisory panel, said, “We all follow the Tyrone Hayes drama, and some people will say, ‘He should just do the science.’ But the science doesn’t speak for itself. Industry has unlimited resources and bully power. Tyrone is the only one calling them out on what they’re doing.” However, she added, “I do think some people feel he has lost his objectivity.”

Keith Solomon, a professor emeritus at the University of Guelph, Ontario, who has received funding from Syngenta and served on the EcoRisk panel, noted that academics who refuse industry money are not immune from biases; they’re under pressure to produce papers, in order to get tenure and promotions. “If I do an experiment, look at the data every which way, and find nothing, it will not be easy to publish,” he said. “Journals want excitement. They want bad things to happen.”

Hayes, who had gained more than fifty pounds since becoming tenured, wore bright scarves draped over his suit and silver earrings from Tibet. At the end of his lectures, he broke into rhyme: “I see a ruse / intentionally constructed to confuse the news / well, I’ve taken it upon myself to defuse the clues / so that you can choose / and to demonstrate the objectivity of the methods I use.” At some of his lectures, Hayes warned that the consequences of atrazine use were disproportionately felt by people of color. “If you’re black or Hispanic, you’re more likely to live or work in areas where you’re exposed to crap,” he said. He explained that “on the one side I’m trying to play by the ivory-tower rules, and on the other side people are playing by a different set of rules.” Syngenta was speaking directly to the public, whereas scientists were publishing their research in “magazines that you can’t buy in Barnes and Noble.”

Hayes was confident that at the next E.P.A. hearing there would be enough evidence to ban atrazine, but in 2010 the agency found that the studies indicating risk to humans were too limited. Two years later, during another review, the E.P.A. determined that atrazine does not affect the sexual development of frogs. By that point, there were seventy-five published studies on the subject, but the E.P.A. excluded the majority of them from consideration, because they did not meet the requirements for quality that the agency had set in 2003. The conclusion was based largely on a set of studies funded by Syngenta and led by Werner Kloas, a professor of endocrinology at Humboldt University, in Berlin. One of the co-authors was Alan Hosmer, a Syngenta scientist whose job, according to a 2004 performance evaluation, included “atrazine defence” and “influencing EPA.”

After the hearing, two of the independent experts who had served on the E.P.A.’s scientific

advisory panel, along with fifteen other scientists, wrote a paper (not yet published) complaining that the agency had repeatedly ignored the panel's recommendations and that it placed "human health and the environment at the mercy of industry." "The EPA works with industry to set up the methodology for such studies with the outcome often that industry is the only institution that can afford to conduct the research," they wrote. The Kloas study was the most comprehensive of its kind: its researchers had been scrutinized by an outside auditor, and their raw data turned over to the E.P.A. But the scientists wrote that one set of studies on a single species was "not a sufficient edifice on which to build a regular assessment." Citing a paper by Hayes, who had done an analysis of sixteen atrazine studies, they wrote that "the single best predictor of whether or not the herbicide atrazine had a significant effect in a study was the funding source."

In another paper, in *Policy Perspective*, Jason Rohr, an ecologist at the University of South Florida, who served on an E.P.A. panel, criticized the "lucrative 'science for hire' industry, where scientists are employed to dispute data." He wrote that a Syngenta-funded review of the atrazine literature had arguably misrepresented more than fifty studies and made a hundred and forty-four inaccurate or misleading statements, of which "96.5% appeared to be beneficial for Syngenta." Rohr, who has conducted several experiments involving atrazine, said that, at conferences, "I regularly get peppered with questions from Syngenta cronies trying to discount my research. They try to poke holes in the research rather than appreciate the adverse effects of the chemicals." He said, "I have colleagues whom I've tried to recruit, and they've told me that they're not willing to delve into this sort of research, because they don't want the headache of having to defend their credibility."

Deborah Cory-Slechta, a former member of the E.P.A.'s science advisory board, said that she, too, felt that Syngenta was trying to undermine her work. A professor at the University of Rochester Medical Center, Cory-Slechta studies how the herbicide paraquat may contribute to diseases of the nervous system. "The folks from Syngenta used to follow me to my talks and tell me I wasn't using 'human-relevant doses,'" she said. "They would go up to my students and try to intimidate them. There was this sustained campaign to make it look like my science wasn't legitimate."

Syngenta denied repeated requests for interviews, but Ann Bryan, its senior manager for external communications, told me in an e-mail that some of the studies I was citing were unreliable or unsound. When I mentioned a recent paper in the *American Journal of Medical Genetics*, which showed associations between a mother's exposure to atrazine and the likelihood that her son will have an abnormally small penis, undescended testes, or a deformity of the urethra—defects that have increased in the past several decades—she said that the study

had been “reviewed by independent scientists, who found numerous flaws.” She recommended that I speak with the author of the review, David Schwartz, a neuroscientist, who works for Innovative Science Solutions, a consulting firm that specializes in “product defense” and strategies that “give you the power to put your best data forward.” Schwartz told me that epidemiological studies can’t eliminate confounding variables or make claims about causation. “We’ve been incredibly misled by this type of study,” he said.

In 2012, in its settlement of the class-action suits, Syngenta agreed to pay a hundred and five million dollars to reimburse more than a thousand water systems for the cost of filtering atrazine from drinking water, but the company denies all wrongdoing. Bryan told me that “atrazine does not and, in fact, cannot cause adverse health effects at any level that people would ever be exposed to in the real-world environment.” She wrote that she was “troubled by a suggestion that we have ever tried to discredit anyone. Our focus has always been on communicating the science and setting the record straight.” She noted that “virtually every well-known brand, or even well-known issue, has a communications program behind it. Atrazine’s no different.”

Last August, Hayes put his experiments on hold. He said that his fees for animal care had risen eightfold in a decade, and that he couldn’t afford to maintain his research program. He accused the university of charging him more than other researchers in his department; in response, the director of the office of laboratory-animal care sent detailed charts illustrating that he is charged according to standard campus-wide rates, which have increased for most researchers in recent years. In an online *Forbes* op-ed, Jon Entine, a journalist who is listed in Syngenta’s records as a supportive “third party,” accused Hayes of being attached to conspiracy theories, and of leading the “international regulatory community on a wild goose chase,” which “borders on criminal.”

By late November, Hayes’s lab had resumed work. He was using private grants to support his students rather than to pay outstanding fees, and the lab was accumulating debt. Two days before Thanksgiving, Hayes and his students discussed their holiday plans. He was wearing an oversized orange sweatshirt, gym shorts, and running shoes, and a former student, Diana Salazar Guerrero, was eating fries that another student had left on the table. Hayes encouraged her to come to his Thanksgiving dinner and to move into the bedroom of his son, who is now a student at Oberlin. Guerrero had just put down half the deposit on a new apartment, but Hayes was disturbed by her description of her new roommate. “Are you sure you can trust him?” he asked.

Hayes had just returned from Mar del Plata, Argentina. He had flown fifteen hours and

driven two hundred and fifty miles to give a thirty-minute lecture on atrazine. Guerrero said, “Sometimes I’m just, like, ‘Why don’t you let it go, Tyrone? It’s been fifteen years! How do you have the energy for this?’ ” With more scientists documenting the risks of atrazine, she assumed he’d be inclined to move on. “Originally, it was just this crazy guy at Berkeley, and you can throw the Berserkley thing at anyone,” she said. “But now the tide is turning.”

In a recent paper in the *Journal of Steroid Biochemistry and Molecular Biology*, Hayes and twenty-one other scientists applied the criteria of Sir Austin Bradford Hill, who, in 1965, outlined the conditions necessary for a causal relationship, to atrazine studies across different vertebrate classes. They argued that independent lines of evidence consistently showed that atrazine disrupts male reproductive development. Hayes’s lab was working on two more studies that explore how atrazine affects the sexual behavior of frogs. When I asked him what he would do if the E.P.A., which is conducting another review of the safety of atrazine this year, were to ban the herbicide, he joked, “I’d probably get depressed again.”

Not long ago, Hayes saw a description of himself on Wikipedia that he found disrespectful, and he wasn’t sure whether it was an attack by Syngenta or whether there were simply members of the public who thought poorly of him. He felt deflated when he remembered the arguments he’d had with Syngenta-funded pundits. “It’s one thing if you go after me because you have a philosophical disagreement with my science or if you think I’m raising alarm where there shouldn’t be any,” he said. “But they didn’t even have their own opinions. Someone was paying them to take a position.” He wondered if there was something inherently insane about the act of whistle-blowing; maybe only crazy people persisted. He was ready for a fight, but he seemed to be searching for his opponent.

One of his first graduate students, Nigel Noriega, who runs an organization devoted to conserving tropical forests, told me that he was still recovering from the experience of his atrazine research, a decade before. He had come to see science as a rigid culture, “its own club, an élite society,” Noriega said. “And Tyrone didn’t conform to the social aspects of being a scientist.” Noriega worried that the public had little understanding of the context that gives rise to scientific findings. “It is not helpful to anyone to assume that scientists are authoritative,” he said. “A good scientist spends his whole career questioning his own facts. One of the most dangerous things you can do is believe.” ♦

*An earlier version of this article did not properly credit the organization that produced and co-published the report with *Environmental Health News*; it was *100Reporters*.

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