GWEN OTTINGER
with RACHEL ZURER

Drowning in Data

Monitoring the chemical content of the air near chemical plants provides valuable data, but it becomes useful only when it is paired with epidemiological data about the local population.

I was at the most undignified moment of moving into my new office—barefoot and on tiptoes on my desk, arranging books on a high shelf—when one of my fellow professors at the University of Washington–Bothell walked in to introduce himself. Pulling my shirt firmly over my waistband, I clambered down to shake his hand and exchange the vital information that begins academic acquaintanceships: Where had I come from? What kind of research did I do?

I felt my shoulders tense, bracing for the question I knew was probably coming next. I explained that I studied communities living next to oil refineries, especially how residents and refinery experts make claims about the effects of chemical emissions on people's health. My colleague replied with what I'd been hoping he wouldn't: "But is it really the emissions from the refineries that are making those people sick?"

An important question, to be sure—essential, even, to policymakers deciding how refineries and petrochemical plants ought to be sited and regulated. So it's hardly a surprise that in the decade since I started my research, I've been asked The Question scores of times, in settings that range from conference presentations to New Orleans dive bars. Yet it's a vexed question, and I have always been frustrated and often struck dumb with my inability to answer it. "There's a lot of controversy over that," I explained to my colleague in my best anthropologist-of-science manner. "The truth is that we don't really know enough to say for sure."

But as I returned to the solitary work of shelving books, I sought refuge in a place that had recently become my favorite environmental fantasy: A brown, windswept hill at the edge of a refinery in the San Francisco Bay area, topped by a small white trailer the size of a backyard tool shed. In my imagination, the trailer glows in the California sun as the state-of-the-art monitoring instruments inside it hum and flash, measuring minute by minute what's in the air. In my imagination, a cadre of scientists peers at computer screens to turn these data into a more satisfying answer to The Question, an answer that matches real-time chemical concentrations with the health concerns of people living nearby.

My fantasy is set in a real place, though I've never seen it. The hill of my imagination overlooks the town of Benicia, a bedroom community of 30,000, where people who drive tight-lipped to San Francisco jobs all week stroll past the antique shops to First Street for scones and lattes on Saturday morning. It's a charming place, yet Benicia's industrial past persists; a slim smokestack pokes up like a flagpole beyond the trailer, its white plume meandering off toward the Carquinez Strait. Benicia is home to one of the 150 or so oil

These "fenceline communities" are places where people cough. Where they carry asthma inhalers. Where every resident has a handful of neighbors who have died of cancer. Where refinery and government officials insist that chemicals in the air don't harm them, and residents are sure that they know better.

refineries that feed the nation's appetite for energy. Less than a mile from downtown, an Oz of tanks and towers on 800 acres churns away day and night, turning up to 170,000 barrels of oil per day into gasoline, asphalt, jet fuel, and other petroleum products. The Valero facility is the town's biggest employer and the major denizen of Benicia's industrial park. The trailer sits on its southern edge.

Most of the communities I have studied are clustered in the South and are smaller, poorer, and more economically dependent on their refineries than is Benicia. For them, the trailer and the data it offers are even more urgent than they are for Benicia residents. These "fenceline communities" are places where people cough. Where they carry asthma inhalers. Where every resident has a handful of neighbors who have died of cancer. Where refinery and government officials insist that chemicals in the air don't harm them, and residents are sure that they know better. These communities are places where conflict lingers in the air along with the smell of sulfur.

Data that can show how chemical exposures are related to health symptoms could help these communities. It could suggest the kinds of protection they need, could show the real extent of emissions reductions necessary on the part of the refineries, could point the way to improved environmental policies. In my mind, Benicia's trailer gleams with the possibility of new knowledge that helps everyone.

But a few weeks after my colleague's visit, my hopes for the trailer dimmed. As I was putting the finishing touches on a syllabus in my office, by now already messy, the phone rang. It was Don Gamiles, an engineer whose company installed Benicia's trailer. He had been excited about the project in Benicia from the time he first mentioned it to me earlier in the summer.

Gamiles has been involved in air monitoring since the aftermath of the Persian Gulf War, when he ran equipment to detect potential poison gas releases during United Nations inspections of Iraqi facilities. He's invented two instruments that can measure concentrations of toxic gases in real time, both of which are part of the suite of monitors that he pulled together for the trailer in Benicia. But these days, Gamiles's business really centers on mediating conflicts between facilities that release those gases and neighboring communities concerned about them. Affable and unassuming in his characteristic polo shirt and khakis, Gamiles works with both sides to design and install suites of monitors, like the one in Benicia, that incorporate his instruments and produce solid data about what's in the air so that neither side can exaggerate. "Everyone's a little bit right," he says. "The refinery guys tend to over-trivialize what's coming out. But communities want to make them the villain."

Though he's been involved in other projects (one major refiner is even talking about making Gamiles's monitors a standard part of their environmental best practices), the Benicia project is what Gamiles raves about: "The sampling station's the best in the world," he said, reminding me that it can monitor hydrogen sulfide, black carbon, and particulates in addition to hazardous air pollutants such as benzene, xylene, and toluene, all for a very reasonable price tag. And the best part: "Everybody's happy!" He chuckled and I imagined his self-effacing grin. "This is a model of how to do things right."

"There's just this one sticking point," he added. He'd called to ask for my help. The refinery and the community group that pushed for the monitors were having trouble figuring out how to present the data. If the monitors detected chemicals, how could they best explain what that meant to someone looking at that data on a public Web site?

The refinery, it seemed, wanted to avoid alarmism and irate hordes at their gates; on the other hand, it was in no one's interest if they swept real risks under the rug. "Everybody has a valid point," Gamiles said. "What would be helpful to have is a listing of standards for all of this stuff"—all of the chemicals that the monitoring station could be detecting, starting with benzene, toluene, xylene, and sulfur dioxide. Could I work with a student to put together a list?

My heart sank. Here was The Question again, in a more nuanced form. Gamiles was asking, "At what exposure levels do emissions from refineries make people sick?" Worse,

this wasn't the first time I'd been asked to take stock of the available information, and what I'd found the last time had driven me to my fantasies of fancy new monitors in the first place.

Buckets of data

In the summer of 2001, I was halfway through my 20s and a Ph.D. program when I walked into the Oakland, California, offices of a nonprofit organization called Communities for a Better Environment (CBE). After years with my nose in a book, I was dying to do something "real" and antsy about finding a focus for my thesis project. I hoped that interning for CBE, whose lawyers, scientists, and organizers worked with Northern California communities to advocate for environmental justice, might address both problems at once.

No one was at the reception desk, so I hung by the door, fingering pamphlets and newsletters announcing the organization's latest successes, including its work helping refinery-adjacent communities establish "bucket brigades" to monitor air quality with do-it-yourself air samplers made from hardware store supplies. Eventually someone bustled past and directed me to the Science Department at the end of one of the office's warren-like hallways.

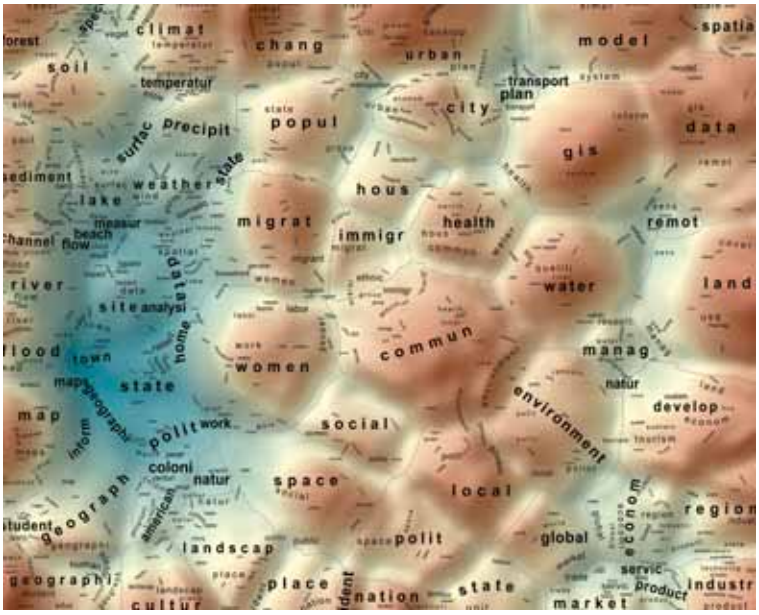
My first assignment seemed simple enough: Communities were getting data with their bucket samples, but they were having a hard time saying what the numbers meant. My job was to compile a list of the state and federal air standards for different chemicals that might show up in a bucket sample. The list would be like a yardstick that citizens could use to put air quality readings in perspective, showing how the numbers measured up to the thick black line that separated "safe" from "dangerous."

As a starting place, my supervisor handed me a second-generation photocopy of a fax containing a table of numbers. The fax was from Wilma Subra, a MacArthur "genius grant"–winning chemist and legend among refinery-adjacent communities in Louisiana. Subra's document listed "levels of concern"; specifically, the regulatory standards set by Louisiana and nonenforceable "screening level" recommendations from the neighboring state of Texas. I was to expand the table, adding comparable standards from other agencies, to give bucket users a straightforward way to know when the concentrations they measured were cause for alarm.

Squinting at a computer screen from the corner of a borrowed desk, navigating through one agency Web page after another in search of air quality standards, I had no problem adding columns to Subra's chart. Agencies such as the Louisiana Department of Environmental Quality (LDEQ), its counterparts in Texas and North Carolina, and the American Toxic Substances and Disease Registry set standards or made recommendations for acceptable ambient air levels of individual chemicals. But each included only a subset of the chemicals I was looking for. The federal Clean Air Act, for example, set limits on total volatile organic compounds, a category that includes these chemicals, but not on the individual air toxins under that umbrella, such as benzene, toluene, and xylene: monoaromatic hydrocarbons known or suspected to cause cancer.

As the table grew, I was surprised to find that there was no consensus on what constituted a safe or permissible level for any of the chemicals. Even after I'd converted the disparate standards into a common unit of measurement, reading across any one row (for benzene, say, or hydrogen sulfide), there were numbers in the single digits, in the double digits, decimal numbers. The lack of consensus was apparent even in the table's header row: One agency set limits on 8-hour average levels, the next on annual averages, the next on 24-hour averages. There didn't even seem to be agreement on what period was most appropriate for any given chemical. I didn't have a single yardstick; I had several of them, each for a different kind of measurement, each with multiple black lines. How would this help anyone figure out what chemical concentrations they should worry about?

At my boss's urging, I made some phone calls to find out how the agencies could arrive at such different standards. A scientist at the LDEQ explained that his agency used occupational health studies—studies of how workers were affected by the chemicals—and multiplied the results by a



In Terms of Geography

André Skupin, 2005

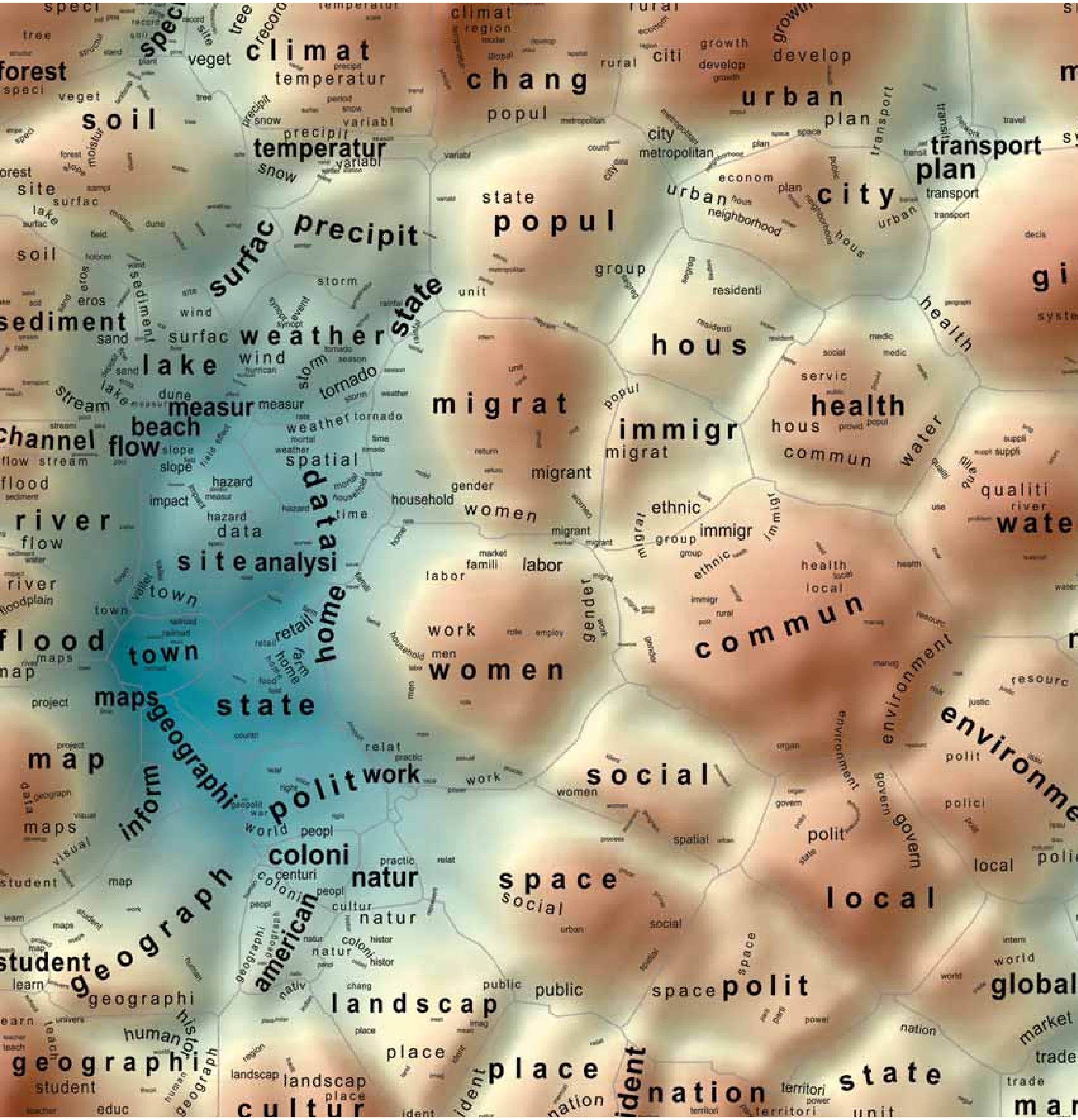
AIM

Many areas of research are extensive in terms of data, published works, scholarly expertise, and practice. Social and intellectual interrelations are highly complex. How can we gain access to broad, global structures of whole research domains as well as to finer, regional, and local structures within subdisciplines? How can we understand major areas, existing and nonexisting connections, and the homogeneity of subareas? Skupin seeks to understand how cartographic design and geographic technology can be applied to map not only geographic space but also abstract semantic spaces.

INTERPRETATION

The map shows the content coverage of geography research for the 10-year period from 1993 to 2002. It was generated from more than 22,000 abstracts submitted to the annual meetings of the Association of American Geographers. Mountains represent areas of higher topical focus, with word stems serving as labels. Community studies are most dominant in the middle of the map. Soil, climate, population, migration, women, social, and health are other major areas of study. Valleys represent regions with less topical focus. One can think of these as capturing information sediments from the surrounding mountains, leading to a mixture of topics. For example, nature and management are valleys surrounded by the major mountains of water, land, development, and environment.

Notice how the arrangement of labeled mountains and valleys replicates major global subdivisions of the geographic knowledge domain. The upper left corner contains topics associated with physical geography, while the upper right corner—including GIS, model, spatial, and data—covers the area now known as geographic information science. Much of the remainder of the map reflects various topics investigated within human geography, including such further subdivisions as economic geography in the lower right corner. Conversely, smaller topical structures within the major mountains are visible, such as the cover and use regions of the land mountain, which reflect documents containing the phrases "land cover" and "land use." *Courtesy of André Skupin.*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scaling factor. I remembered the number from my graduate class in risk analysis: it adjusted risk levels based on 8-hour-a-day, 5-day-a-week worker exposures to numbers appropriate for populations such as people living near refineries that could be exposed to the same chemicals for as much as 24 hours a day, 7 days a week.

A Texas regulator, in contrast, told me that her agency based its recommendations mostly on laboratory studies. I knew about this process from my class, too. Groups of mice or rats or other small animals would be exposed to varying levels of a chemical to determine the highest dose at which the animals didn't appear to suffer any adverse health effects. The agency scientist would have looked at a number of different studies, some of them with incompatible results, made a judgment about which numbers to use, then applied a safety factor in case human populations were more sensitive to the chemical than other mammals. But what neither she nor her counterpart in Louisiana had to work with were studies of what these chemicals did to people who breathed lots of them at a time, in low doses, every day.

In the end, digging into the standards and learning how incomplete and uncertain they were convinced me that we don't really have a good answer about exactly what the chemical levels mean for health. Anyone who professes to know with certainty is operating as much on belief as on data. So by the time Don Gamiles asked me, nine years later, if I could assemble the standards for the chemical that his shiny new monitoring station was detecting, I wanted to tell him that all he was going to get was a whole bunch of yardsticks. What he needed was an additional stream of data, health data that could put chemical concentrations in the context of real people's experiences and, over time, help put those standards on a firmer footing.

But Gamiles is an engineer, not an epidemiologist. I knew that his contract would not have funding for what I was proposing. And explicitly mentioning the health concerns wasn't likely to help Gamiles maintain the collegiality between the Valero refinery and its neighbors in Benicia.

I took a deep breath and agreed to look for a student who would investigate the standards. Maybe, I told myself, if we could show Gamiles and the engineers at Valero the uncertainties in the standards, we could start a richer conversation about what the data coming from the new monitoring station meant, and how to figure it out.

Having that conversation, or at least trying to, seemed especially important since more and more refineries, especially in environmentally conscious parts of the country such as the San Francisco Bay area, have been seeking Gamiles's services, installing their own monitors before an increasingly vigilant Environmental Protection Agency (EPA) can require them to. And yet part of me knew that imagining I could get refiners and communities to talk about the issue was overly optimistic, if not downright naïve. I already knew that petrochemical companies weren't troubled by the limitations of the standards. In fact, years earlier in Louisiana, I'd seen how they use those very uncertainties and omissions to their advantage.

The lowdown in Louisiana

Many of the air monitors in the trailer in Benicia hadn't yet been developed when Margie Richard decided to take on the Shell Chemical plant across the street from her home in Norco, Louisiana, in the late 1980s. But what was in the air, and what it could do to a person's health, were very much on her mind.

Richard's front windows looked out on an industrial panorama: tall metal cylinders and giant gleaming spheres connected by mazes of pipes, all part of the processes that turn crude oil into gasoline, ethylene, propylene, and industrial solvents. Half a mile away, at the other edge of the 3,700-person town, an oil refinery loomed. On good days, a faint smell of motor oil mixed with rotten eggs hung in the air; on bad days, chemical odors took Richard's breath away.

Throughout Richard's eight-square-block neighborhood of Diamond, the historic home of Norco's African-American population, people were getting sick. Richard's young grandson had asthma attacks that landed him in the emergency room on more than one occasion. Two streets over, Iris Carter's sister died in her forties of a disease that doctors told the family they only ever saw in people living near industrial facilities.

Barely five feet tall and bursting with energy even in her early sixties, Richard led her neighborhood in confronting Shell about its plant's ill effects. Every Tuesday afternoon, she and a few other women with picket signs walked up and down the far side of her street, in front of the chain link fence that separated Shell from the community, demanding that representatives from the company meet with residents to discuss a neighborhood relocation. Concerned about their health and safety, she and other residents wanted out.

By 1998, Richard and her neighbors finally started to get some quantitative data to support their claims that Shell's emissions were making them sick. Denny Larson, then an organizer with CBE in Oakland, arrived with buckets. With the low-tech air sampler—little more than a five-gallon plastic paint bucket with a sealed lid and a special bag inside—Richard documented an incident at Shell Chemical that emitted potentially dangerous concentrations of an indus-

trial solvent called methyl ethyl ketone (MEK). She also gathered evidence that residents of her community were exposed to toxic chemicals when odors were inexplicably bad, and even personally presented a high-ranking Shell official with a bag of air from her community at a shareholder's meeting in the Netherlands.

In 2002, Richard and her group triumphed. Shell agreed to buy out any Diamond residents who wanted to leave. But Richard had succeeded in more than winning relocation. She had also put air monitoring on Shell's agenda, where it had not previously been. That fall, even as families in Diamond were loading moving vans and watching bare ground emerge where their neighborhood had been, Shell Chemical and its Norco counterpart, Motiva Refining, launched their Air Monitoring…Norco program.

Good neighbors

One muggy September afternoon, I picked up a visitor's badge at the guardhouse at Shell Chemical's East Site and made my way to the company's main office building. The rambling, two-story beige-and-brown box could have been in any office park in suburban America, except that in place of manicured gardens and artificial lakes, it was surrounded by distillation towers and cracking units.

David Brignac, manager of Shell's Good Neighbor Initiative, which was overseeing the Air Monitoring…Norco program, greeted me with a boyish grin and a slight Louisiana drawl and led me upstairs to his roomy office. We sat at a small round table with Randy Armstrong, the good-natured but no-nonsense Midwesterner in charge of health, safety, and environment for Shell Norco.

Brignac walked me through a printed-out PowerPoint presentation: Surveys showed that Norco residents thought that there were dangerous chemicals in the air and that they had an impact on people's health. Air Monitoring…Norco sought hard data about what really was in the air.

Scribbling frantically on a legal pad, I noted what he left out as well as what he said. There was no mention of the bucket samples; no suggestion that Shell's decision to relocate Diamond residents may have fueled the perception that the air was somehow tainted; no hint at the regulatory enforcement action, taken in the wake of the MEK release, that required a "beneficial environmental project" of Shell; in short, there was no acknowledgement that the monitoring never would have happened if not for the Diamond community's activism.

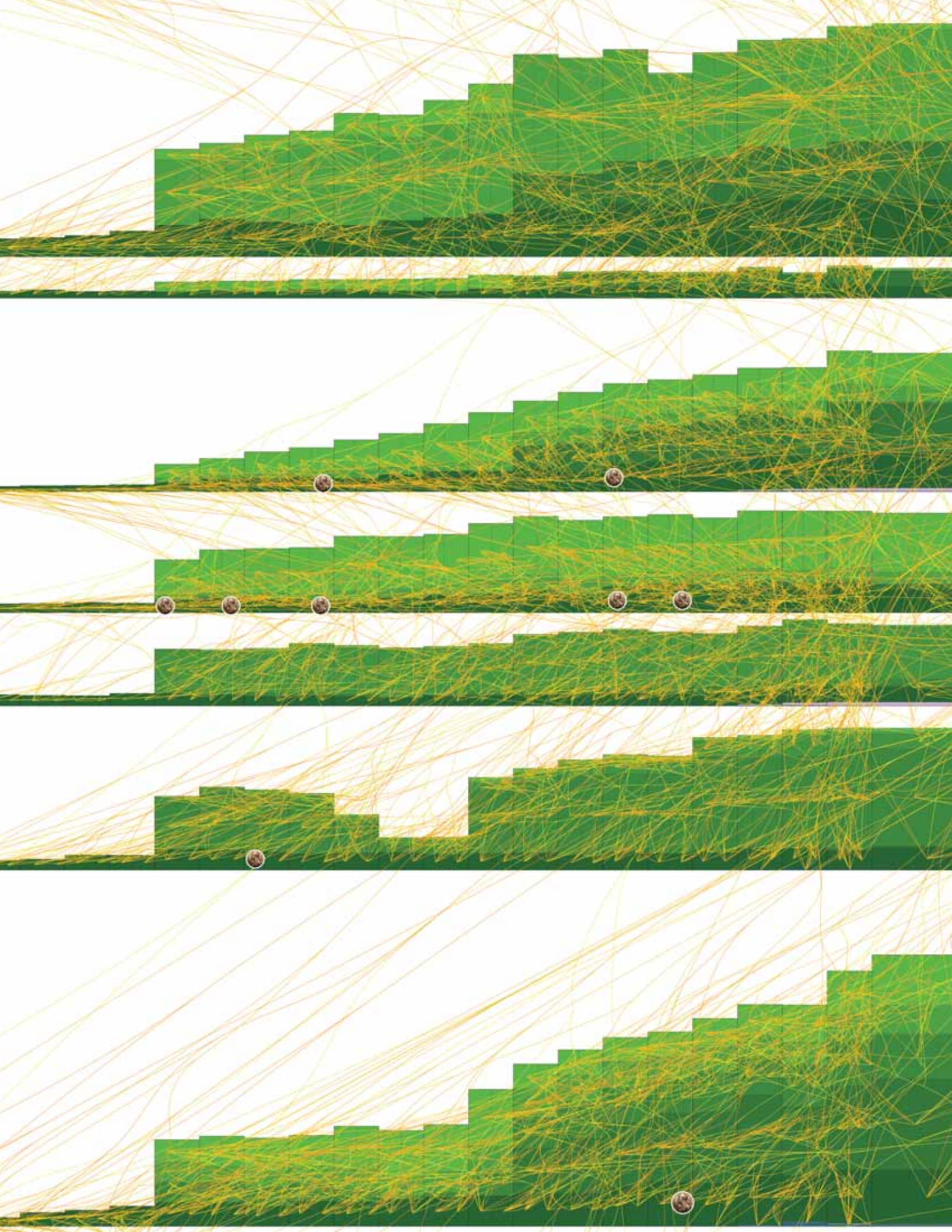
Using their pencils to move me through their talking points, the two engineers described how the data produced by the program would be "objective, meaningful, and believable." Brignac described a planning process that had included not only Shell and Motiva engineers, but also state regulators, university scientists, and community members. Armstrong outlined a sampling procedure that replicated the one used by the LDEQ in their ambient air monitoring program: Each sample would be taken over a 24-hour period, on rotating days of the week (Monday this week, Sunday next), and their results averaged together, all to ensure that the data gave a "representative" picture of Norco's air quality and not anomalous fluctuations.

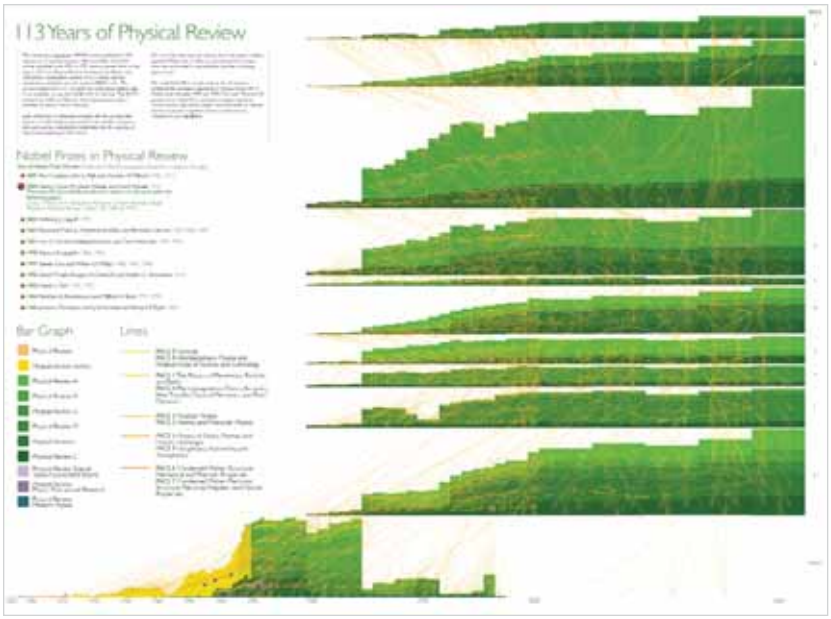
Like all good scientists, Brignac and Armstrong acknowledged that they didn't know what their study would find. They monitored emissions leaving the plant, Armstrong explained, and used computer models to predict how they would disperse into surrounding areas. Those models gave them every reason to believe that the air quality was fine. And the company had done studies of its workers' health, which also gave them confidence that their emissions weren't making anyone sick. But we all knew that models aren't measurements, and the health of adult plant workers may or may not say anything about the health of residential populations that include the very young and very old. So with a slightly nervous laugh (or was that my imagination?), Armstrong assured me that Shell would be releasing the results even if they showed that air quality was worse than they had thought.

Nearly six months later, I followed Margie Richard, now a resident of the nearby town of Destrehan, into Norco's echoey, warehouse-like American Legion Hall. Brignac and Armstrong milled with their colleagues near the table of crackers, cheese, and that unfathomable Louisiana delicacy, the shrimp mold. They greeted us warmly as the facilitator began to usher people to their seats for the presentation of Air Monitoring…Norco's first set of results.

A nervous young African-American man from Brignac's Good Neighbor Initiative team began by explaining the rationale and process of the program, using more or less the same slides that I had seen in September. Then a white 30-something from the independent firm that had carried out the monitoring, less polished than his Shell counterparts and looking uncomfortable in his tie, gave us the results. The headline: "Norco's air meets state standards." They had compared the concentrations measured in Norco, he explained, to limits on chemical concentrations set by the LDEQ, and the measured levels were below the regulatory limits.

Neither the contractor nor the assembled Shell representatives said so explicitly, but the conclusion they wished us to draw was clear: Air quality in Norco met the state's standards, so it was perfectly healthy to breathe. I wanted to ob-





113 Years of Physical Review

Bruce W. Herr II, Russell J. Duhon, Elisha F. Hardy, Shashikant Penumarthy, and Katy Börner, 2007

AIM

How did the field of physics evolve over the last 100 years? When did the many different subfields of physics emerge, die, split, and merge? How are these subfields connected via permanent citation linkages woven by thousands of physicists over the many decades? Can the web of papers their authors interlinked via coauthor and paper-citation linkages be used to identify high-impact papers? Can it be mined to predict the future, or at least the next Nobel laureate?

INTERPRETATION

This is the very first map of a 113-year scholarly data set that captures the structure and evolution of the entire field of physics. The visualization aggregates 389,899 papers published in 720 volumes of 11 journals between 1893 and 2005. Time runs horizontally. In 1975, the Physical Review introduced the Physics and Astronomy Classification Scheme (PACS) codes. In this visualization, the top-level PACS codes run vertically and are labeled from PACS 0 General to PACS 9 Geophysics, Astronomy and Astrophysics on the right. The 91,762 papers published from 1893 to 1976 take up the left third of the map. The 217,503 papers published from 1977 to 2000, for which there are references but no citation data, occupy the middle third of the map. The 80,634 papers from 2001 to 2005, for which citation data is available, fill the last third of the map. Each annual bar is further subdivided vertically into journals, and each journal is further subdivided horizontally into the volumes of the journal. The size of each journal-by-volume area is proportional to the number of papers published. Overlaid on this two-dimensional base map are all citations from every Physical Review paper published in 2005.

Each year, Thomson Reuters predicts three Nobel Prize awardees in physics based on data from its ISI Web of Knowledge, including citation counts, high-impact papers, and discoveries or themes worthy of special recognition. The map uses small Nobel Prize medals to indicate all Nobel prize–winning papers. Correct predictions are highlighted. *Courtesy of Indiana University.*

ject. How could they say that when there were no standards for some of the chemicals that they measured? When Louisiana's standards represented just one version of where scientists drew the line between "healthy" and "dangerous"? I sat on my hands and held my tongue; rabble-rousing at public meetings is not an anthropologist's mandate, especially when she hopes to continue interviewing all sides.

But I wasn't the only one inclined to question the implication that "meets standards" was the same as "safe." In the question-and-answer period, a middle-aged African-American woman, her graying cornrow braids piled neatly in a bun, stood up and asked just how good those standards were. How could we know that they were strict enough? One of the university scientists involved in the project, a public health researcher from Tulane, reassured her that the standards were based on the best available scientific studies and updated as new information became available. Shell's engineers nodded their approval. For them, it seemed, Air Monitoring…Norco had settled the matter: There was no reason to think that emissions from Shell were making anyone sick.

Elsewhere in the audience, Margie Richard pursed her lips. I couldn't tell what she was thinking, but the fact that she was there at all, even after having moved away from Norco, suggested that the Air Monitoring…Norco program had been an important aspect of her group's victory. For years, her group had been calling for hard data about the chemicals they were exposed to, and they had gotten it. But in the drafty warehouse, the victory seemed hollow. Shell had interpreted their data in the context of questionable standards in order to prove what they had believed all along. I wondered if Richard was disappointed. I was.

The story didn't have to end there, of course. Residents of Diamond and other fenceline communities had challenged the industry's science before with their bucket samples. They could likewise have launched an attack on the idea that "meeting standards" was the same as "safe" and insisted on health monitoring to go along with the air monitoring. But their relocation victory meant that Diamond's activists were already scattered to new neighborhoods. Battles over the adequacy of standards were not likely to be fought in Norco.

Yet the question remains for other communities: As more and more facilities set up air monitoring programs to satisfy the demands of concerned neighbors, will community activists continue to push to see that monitoring data are used to get better answers about how chemicals affect their health? Or will they accept comparisons to existing standards that rubber-stamp the status quo? Whether the trailer in Benicia turns out to be the breakthrough I've been imagining it to be rests on what residents do with its data.

California dreaming

When I talked to Don Gamiles in the fall, I had my own favor to ask of him: Would he talk to my colleague, Oakland-based writer Rachel Zurer, and introduce her to the people he had been working with in Benicia? We were working together on a story about monitoring and wanted to know more about the exemplary collaboration that he was involved in. Valero, it turns out, wasn't ready to talk about the project; perhaps they didn't want anyone wondering why the public didn't have access to the data yet. But Marilyn Bardet, the founder of the citizen's group in Benicia that helped pressure the company to install the air monitoring trailer, was more than happy to meet with Zurer.

On a blustery morning in October 2010, Bardet welcomed Zurer into her manicured bungalow on Benicia's east side, then retreated to her office to finish an e-mail. Zurer was left to nose around in the dining room, where Bardet's dual identities were on display.

Bardet, 62, is professional artist who seems to spend as much time as a community activist as she does painting and writing poems. The walls, shelves, end tables, and cupboards of the dining room were decorated with paintings, sculptures, and shells. But the wood of the dining table hid beneath stacks of papers and files relating to Bardet's newest project: a bid to help her town qualify for federal funding to clean up an old munitions site in town, money she said that city employees hadn't known to request.

Bardet assumes that she has a yardstick that shows where "safe" levels of toxins and particulates in the air become dangerous ones, and that there are reliable benchmarks that would tell teachers when they should close their windows and city officials when more traffic would be too much.

Bardet returned in a few minutes, talking quickly. That afternoon she had a meeting scheduled with some Valero officials to keep working out the details of the air monitor's Web site—trying to work through the problem that Gamiles had brought up on the phone, of how to present the data publicly—and she'd been sending them a last-minute memo reiterating her goals for the project. As she gathered her car keys and led Zurer out the door for a tour, she caught her guest up on the details.

Some Benicia residents don't think about the refinery, Bardet explained as she drove under the freeway, past an elementary school, and turned left and uphill just before reaching the Valero property's southern border. It doesn't fit the image of their quaint, comfortable town, and as luck would have it, the prevailing winds tend to sweep refinery odors away from the people, out to sea. The refinery has a good safety record and no history of major conflicts with its neighbors. From many places in town, it's invisible.

Yet Bardet and her fellow members of the Good Neighbors Steering Committee (GNSC) keep a sharp eye on Valero. Keenly conscious of the toxic problems other fenceline communities such as Norco have faced, they are wary of the industrial giant in their midst. The air monitoring station is a product of their vigilance. In 2008, the company made changes to some construction plans without going through the full environmental review that those changes required. Dexterous in navigating the intricacies of bureaucratic requirements, Bardet and the GNSC used Valero's mistake to require the refinery to pay for environmental benefits in Benicia. A single letter Bardet wrote detailing Valero's missteps, plus many hours of work by the GNSC, netted the community $14 million. The monitoring trailer was part of the package.

Bardet parked the car at the end of a residential cul-de-sac and escorted Zurer to a spot under an ash tree in the vacant lot between number 248 (white picket fence, a baby-blue Volkswagen Bug in the driveway) and number 217 (single-story ranch with gray siding, two boats, and a satellite dish). She pointed toward the minor white bump on the horizon, curtained by tall stalks of thistles atop a small brown hill a hundred yards across an empty field. It was the monitoring station that I'd been conjuring in my imagination since Gamiles first mentioned it.

"You wouldn't know that this is a big deal," Bardet said. And it was true. In person, the trailer looked like nothing special. But back in the car again, through lunch at a restaurant in town, all the way until Bardet zoomed off to her meeting with Valero, Bardet shared with Zurer her vision of what the monitors might mean for her community, and for her future as an activist.

"It's not just the refinery," she explained. She pointed out that, for example, while Benicia's elementary school is less than a mile from Valero, it's also near a corporation yard, a gas station, a highway cloverleaf, and the major road through town. The air monitors and weather station could expose exactly which pollutants are infiltrating the school, from where, and under what conditions.

"With that information, you can give a school district an idea of how to improve their site, so you can mitigate it," she said. Teachers could avoid opening windows during rush hour. Or community activists like Bardet would have the data they'd need to evaluate the effect of a new development that would add more traffic to the road. "Policy needs to be evidence-based," Bardet explained to Zurer. "That's what we're after."

Scientific realities

Zurer called with her report on her meeting with Bardet as I was answering a flurry of e-mails from students worried about their final papers. Hearing Bardet's vision for the monitoring station, my hopes sank further. It wasn't that they weren't going to use the data; indeed, it seemed that the information that the monitoring station produces will be something that Bardet can leverage in her myriad projects to improve her community. But in her pursuit of evidence-based policy, Bardet takes for granted the same thing that the engineers at Shell did and that Gamiles does. She assumes that she has a yardstick that shows where "safe" levels of toxins

and particulates in the air become dangerous ones, and that there are reliable benchmarks that would tell teachers when they should close their windows and city officials when more traffic would be too much.

Maybe my pessimism is ill-founded. Maybe the ongoing struggle between Valero and residents over how to present the data will ultimately open the Pandora's box of questions surrounding air quality standards—how they're set, how good they are, how they could be improved—and convince Bardet that she needs a better yardstick. Maybe an enterprising epidemiologist will be seduced by the vast quantities of exposure data that this monitoring station, and others around the Bay area, are producing and persuade Bardet and her group to institute complementary health monitoring in order to create a better yardstick. Maybe the Centers for Disease Control's National Conversation on Public Health and Chemical Exposures, which acknowledges the importance of environmental health monitoring, will help convince government agencies to sponsor such a study.

Maybe, in the end, it was just the stack of grading on my desk that had sucked my hope away. But despite the piles of new information that Benicia's monitoring station will produce—is, indeed, already producing—I couldn't convince myself that any new knowledge would be made, at least not in the absence of more fundamental changes. I wandered off to the faculty holiday party conjuring a new daydream: The National Institute of Environmental Health Sciences would call for proposals for studies correlating air monitoring with environmental health monitoring; the EPA, making ambient air toxics standards a new priority, would demand that data from fenceline communities be a cornerstone of the process; and Marilyn Bardet would seize on the new opportunities and make her community part of creating a better answer to The Question.

Recommended reading

Rebecca Head, "Health-based Standards: What Role in Environmental Justice?" in *Environmental Justice: Issues, Policies, and Solutions*, ed. Bunyan Bryant (Washington, DC: Island Press, 1995).

Steve Lerner, *Diamond: A Struggle for Justice in Louisiana's Chemical Corridor* (Cambridge, MA: MIT Press, 2005).

Monitoring Work Group, *National Conversation on Public Health and Chemical Exposures: Draft Monitoring Work Group Report,* 2010; available at http://www.resolv.org/nationalconversation/reports/Monitoring_Draft_Report.pdf.

Gwen Ottinger, "Epistemic Fencelines: Air Monitoring Instruments and Expert-Resident Boundaries," *Spontaneous Generations* 3, no. 1 (2009): 55–67; available at http://spontaneousgenerations.library.utoronto.ca/index.php/SpontaneousGenerations/article/viewArticle/6115.

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Sylvia Noble Tesh, *Uncertain Hazards: Environmental Activists and Scientific Proof* (Ithaca, NY: Cornell University Press, 2000).

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This article is part of the New Voices, New Approaches series in which young scientists team up with professional writers to produce policy articles with a narrative structure.