

## WHERE I COME FROM

The Lord giveth and the Lord taketh away,  
but He is no longer the only one to do so.

—ALDO LEOPOLD

DONORA, PENNSYLVANIA, was the kind of place where an adventurous three-year-old like my brother Marty could wander five miles away from home and never really be lost. He made front-page headlines both times he did it—"Runaway Marty Does It Again!" read the second one. Each time, somebody brought him back up the steep hills, around the curvy, slag-lined, coal-paved roads, back to our house.

All of us children roamed free. Behind my house was a barren stretch of caked, light brown earth the size of two football fields. At its edge, the smooth, dusty ground sloped down, at an angle perfect for sliding, to some black ditches with iridescent pools of oily water at the bottom. After a few hours of playing with my friends in the fantastic cracks and crevices of this field, I usually found myself half a mile down the road, at my beloved grandmother Bubbe Pearl's house. She was always home, and her bedroom was perfumed with the smell of chicken soup.

Nestled into the hill inside a sharp horseshoe bend in the Monongahela River, Donora had sprung up around its metalworks and steel industry. In 1900, William Donner began building an iron mill alongside

the fast-moving river, and enough immigrants showed up for jobs that the town was officially incorporated a year later. By midcentury it featured a church or two on most corners, an intense Little League system and one of the best high-school football teams in the valley. The main street ran for two blocks with no traffic light and was anchored at one end by the Fraternal Order of Eagles, the Masons, the Polish Falcons, the Sons of Croatia, and a bowling alley. An ice-cream cone with two big scoops cost a nickel at Weiss's Drugstore, and at Niccolanco's, a single penny could buy a child's fortune in sugar: five Tootsie Rolls, three red-hot jawbreakers, or ten smaller gum balls.

Nobody needed a clock. Dinner times, school recesses, and PTA meetings were announced by the shrieking mill whistles. When there was a fire, long blasts from the mill would signal what precinct of town the fire was in. Short blasts would indicate the street number. Any time a fire whistle went off, anyone who could stopped whatever he was doing to go help. The firemen were all volunteers.

Everybody in Donora either worked for "the world's largest nail mill," as the sign atop the factory gate announced, or worked to feed, clothe, fuel, or take care of those who did. After a full day in the factory, men would go to work on their second jobs: building the family home. First they would dig a basement, pour a concrete floor, and line it with cement blocks; then they would live there until they had saved enough to buy materials for another floor. Those who made it to the elite rank of machinist, master molder, or welder could build three stories, enough for their kids, their parents, their grandparents and usually some newly arrived cousins from central Europe. Sometimes people lived in their basements for years after they had finished other floors, simply because they could not bear to get the upstairs dirty.

Our house had only one story above the basement—cement blocks covered with pastel green aluminum siding. In the half of the basement that wasn't garage sat two huge steel sinks. When they were full of bubbles of Tide (or occasionally stronger stuff) to wash off the dirt and grease from my various expeditions, I would happily plunge into them. In those days before dryers, wet clothes were wrung through mechanical rollers to squeeze the water out into the tubs. In winter, the basement became a huge network of clotheslines, pins, and clothing in vari-

ous stages of drying-out. Water from the fields turned the garage into an indoor wetland pool in springtime and sent the clothes outside to dry. Upstairs, in the tiny living room that was hardly ever used, we had thick plastic slipcovers on the furniture. The slipcovers never came off, even for company. They had to protect the precious light fabrics underneath, and they had to be wiped down every day.

Donora was a simple town, not pretty in any conventional sense, with cobblestone streets that snaked up and down hills so steep they had stairs instead of sidewalks. It was a young place, full of working people, few of them over sixty—the sort of place where weeks would pass and nobody would die.



In the 1950s, the mills began to shut down, and Donora became a place to leave. Nobody spoke about what was happening. My family moved to Pittsburgh when I was ready to begin high school, searching, like half the town's families, for better opportunities. One day I came home from classes at the University of Pittsburgh, dropped my books in the hall, and said to my mother, "Mom, was there *another* place called Donora?" I had never heard much discussion about where we came from. Now it had grabbed my attention in an unsettling way.

My mother had just put a kettle on to boil. "Why do you ask?" she said.

"Well, there are several Allentowns, several Websters, a couple of Eagles. There's Pittsburg, Kansas, and Pittsburgh, Pennsylvania. So maybe there are a few Donoras?"

She moved into the kitchen and sat down on the bench next to the built-in white table. I followed her in, took a big breath and continued to press. "I read in a book at school that in a town with the same name as ours, there was pollution. Was Donora polluted? Or was there *another* Donora?" I could not imagine that what I'd read had anything to do with where I'd grown up. I had never heard about our town being anything other than a wonderful place. I had never heard of pollution. The word sounded dirty, something to be ashamed of.

The whistle of the teakettle interrupted, and my mother got up to take the pot off the stove. At first I thought she was going to tell me about

someplace else, another Donora somewhere. I was pretty sure of that, but then I could tell she was hesitating. Slowly she poured the steaming water into a small blue cup, dunking the tea bag in briefly. Without even asking if I wanted any, with a nod that commanded me to join her, she poured another blue cup of water, passed the same tea bag into it and handed it to me. We sat across the table from each other with steaming teacups between us. She sighed and finally replied, "Nobody knew from pollution then. That was just the way it was. We didn't think much about it."

"Remember all that grime we had on the cars, how we had to drive with the headlights on in the afternoon? How the sun didn't shine for days at a time? Remember how women always had their curtains hanging out to dry every week? A lot of us gave up on curtains altogether. Venetian blinds were better, because they could be wiped down. My mother's house had thirty-six windows, and we were always washing them. By the time we got to the last one, the first was already soiled. They were never really clean." I had expected an explanation, but what she gave me was a reminiscence.

There in the sunny kitchen of our big house, ten years and thirty miles away from our old town, it felt like we were on another planet. Outside I could see the sunlight on the green grass. Bubbe Pearl had never made it out of Donora. She had once been famous for her strength—the first woman in the valley to hand-crank a Model T Ford. A legendary driver, she frequently drove the nine hours to Atlantic City with her five children in tow, long before there was a Pennsylvania Turnpike. Nobody ever passed her. But when I was growing up, she kept her bed in her dining room because she could not make it up the stairs to a bedroom. She could never be more than a few steps away from an oxygen tank. Traveling beauticians regularly attended to her and to dozens of other women who were too sick to walk up and down the hills to the beauty parlor. When I was very young, I simply assumed that all blue-haired grannies stayed in bed, tethered to oxygen tanks.

"But they say people got really sick in Donora. Did people get sick?"

"Well, we used to say, 'That's not coal dust, that's gold dust.' As long as the mills were working, the town was in business. That's what kept your Zадde and your father employed. Nobody was going to ask if it made a few people ill. People had to eat."

I shot her the kind of skeptical look that daughters have been giving mothers since time immemorial.

"Look, today they might call it pollution," she sighed. "Back then, it was just a living."

So Donora was famous, but no one ever talked about it. We lapsed into silence.



Many years later I visited the remote city of Xinji, famed for eight centuries as the center of leather making in northeastern China. With some colleagues from Beijing Medical University, I was serving as an expert adviser for the United Nations Development Program. The mayor and his city planners proudly showed our delegation around a dazzling display of construction for an entire new town. The years of pollution had left the old industrial center so undeniably putrid that the whole town had recently picked itself up and moved ten miles upwind. As we toured vast areas of new construction, foundations and steel girders, nobody talked about why all this was happening.

One morning I awoke at five o'clock to the sounds of explosions. Still in my nightclothes, I rushed to the open balcony of the still-unfinished hotel where we were staying, clutching my video camera to capture whatever was going on. My colleagues rushed out as well and looked on in horror at the scene below. Smoke billowed everywhere. Workers scurried among simmering vats of black tar as a Feng Shui master set off repeated charges to rout evil.

My Chinese hosts were embarrassed by the noise and stench, but I found myself strangely exhilarated, almost nostalgic. Xinji smelled like home.



Every child in Donora knew how to make steel. You needed limestone, coal, and iron ore. A pamphlet handed out at one of Donora's American Steel & Wire Works' annual open houses explained that a normal day's operation required forty-five carloads of iron ore, forty cars of coke, six

of limestone, and six of miscellaneous materials. Each day, the plant burned as much coal as did all the homes in Pittsburgh.

These ingredients regularly arrived via massive coal-fired barges snaking up the Monongahela River. Along the Donora side of the river, we could watch the barges rising through the intricate system of locks. Huge metal gates would open, the giant vessel would slowly move inside as if being swallowed by some gigantic whale, and then the gates would bellow with the crunching, creaking, groaning sounds of metal on metal as they majestically swept shut. The captain would tie up to the side of the lock with oily, blackened hawsers as thick as my leg, crossing them at bow and stern. The lock master and barge captain would wave a thumbs-up, and hundreds of thousands of gallons of muddy river water would surge into the lock. Then, with a movement that never ceased to amaze us, the ship would gradually inch upward, as though lifted by some phantom force, until it could float out the other side and continue its journey to the mills.

Other supplies came on long freight trains that ran along the river and right through the center of the string of furnaces, rolling mills, and smelters. Still others came right out of the ground nearby. Cliffs of limestone were regularly sliced away with huge shovels, draglines, and half-tracks. Family mines, some in people's backyards, yielded Appalachian coal from some of the richest seams in the world.

More than anything else, coal was essential to keeping Donora alive. It heated our homes and fired the massive furnaces and ovens of the mills. Mountainous piles of coal at the mills meant the town was in business. In addition to needing coal for the furnaces, steelmaking depended on a derivative of coal called coke. Coke is essentially coal with the greasy impurities baked out at hellish temperatures.

As a blacksmith hammers a piece of wrought iron to shape it, he must keep it hot so that it remains soft. In charcoal-fired forges like those in Donora, carbon solids and carbon monoxide remain in contact with the iron surface at relatively high temperatures. The hammered surface combines with small amounts of carbon (the iron is carburized) to create a new alloy. When it contains around one part per thousand of carbon, iron is not ordinary iron any more; it becomes steel. This small trace of carbon distributed throughout the dense mass of iron makes it stronger, so that it

will take a better edge, build a stronger bridge, or support a taller building than almost any other material humans know how to make.

A coke oven in 1950 was a pretty simple affair, a gigantic beehive about the size of a one-car garage, built in honeycomb fashion out of fired bricks. Coal was shoveled in and heated to intense temperatures; coke came out. The gases and smoke that were baked out of the coal were supposed to remain completely in the oven, but they did not. Seductively sweet aromatic hydrocarbons fill the air and ground nearby.

A commercial coking operation required a string of about eighteen ovens, called a battery. Like a great shark that has to keep moving to stay alive, a coke battery had to run all the time, at temperatures above 2,000 degrees Fahrenheit. The ovens had to be blocked shut to assure a constant, even temperature. If they ever cooled, they could not be restarted because the bricks crack below 800 degrees. This meant that once the oven was fired, hardy souls with a good tolerance for heat had to carefully stack bricks together over the opening to keep the temperatures up. Folks who worked the ovens tended to be young.

By the time the workers had finished loading up and firing the last oven, the first one, having been fired the day before, was ready to yield just the right stuff for making the best steel. The oven doors would be opened on both sides, letting air into the chamber. In an instant, the air-starved coke sucked up oxygen and exploded with spectacular flares. Massive amounts of water were needed to quench the flames. Just like steelmaking, coking used thousands of gallons of river water every day.

The water used in steelmaking tends to pick up whatever impurities that are rinsed off materials in the process. Some bright fellow had the idea of using dirty water from other parts of the mills to quench the coke, which made sense except that however poisonous the water was when it came from the mill, it would only be made worse by quenching. Mrs. LaMendola told me she could never get tomatoes to grow in the path where the plume from the ovens ran. On the other side of her house, they did just fine.

In the 1950s, the mills in Donora relied on blast furnaces each of which held 110 net tons of material. The basic process of steelmaking cooked iron ore into pig iron in these massive furnaces and then converted this into steel in open hearths. Molten iron solids would flow

around the center of the blast furnace—an area where nothing moved, called the “dead man”—before dropping to the bottom as pig iron. Every few hours, about 1,450 tons of the heavier molten iron were tapped out into forty-ton brick-lined ladles that would be carried to the open hearths to become steel. Limestone served as a kind of chemical sponge, to dissolve silica and other impurities. When simmered to the right point, this amalgam floated above the liquid pig iron, where it could be skimmed off. Sluice gates from the furnace channeled the steaming leftover slag into waiting gondola cars shaped like giant teacups. The train was hauled to the dump, where its smoldering cargo was poured off between the surrounding bluffs, forming crater-like, jagged edged shapes as it cooled.

On summer evenings, my family and I would sit in lawn chairs behind our house and watch the fiery spray of what was called kish. Brightly burning graphite spewed off the ladles that drew hot iron from the furnace and burned like gigantic, brilliant sparklers. Each minute of the day all year long five vertical engines sucked in 42,000 cubic feet of hot air, yielding thousands of cubic feet of gas. When burned through a single stack atop the furnace, these gases plus lots of reddish iron ore and other dusts flamed at night like a rocket's trail. The spectacle was dazzling.

Making steel requires a furnace that stays constantly fiery to meld the metals. Into the shallow, saucer-shaped open hearths was placed a layer of scrap iron, some iron ore, coke, and limestone, onto which molten pig iron was poured. Preheated air mixed with gas forced the layers to melt into a white molten mass, at a temperature of at least 2,600 degrees Fahrenheit. At this heat, reactions in the cauldron forced out all air, leaving liquid metal that formed a dense, strong solid when it cooled.

The remaining white-hot liquid steel moved slowly on tracks inside the mill, where it was poured from huge ladles into five-ton molds to make ingots. An ingot was about the length of two men and the width of one—hot, heavy, and forbidding. After three hours, the ingots were stripped from their molds, still steaming red hot, and put into soaking pits before being shipped on open railroad tracks that connected the entire complex to the blooming and billet mills. Cranes mounted on massive beams built into the roof of the mill would pick up the ingots as if

they were Tinkertoys and deposit them on a conveyer table. There they went through gigantic rolling pins for stretching and shaping into sheets, plates, and bars—the building blocks for the essentials of industrial life.

With much of steelmaking, there is little room for error. The carbon that remained in the final product determined whether what came out of the furnace was iron or steel. More carbon makes a harder, denser steel, but this steel becomes increasingly brittle.

A few years before I was born, a steelworker fell into the ladle used to draw off the molten brew, just as the furnace was being tapped. They said he'd been drinking, though how this was proved is beyond me. Not a single body part was recovered. They buried the bucket outside, near the furnace.

I loved the spectacular shower of sparks and sprawling fires that lit up the sky for miles, glowing with fiery dusts and gases from the furnaces. It was a fiercely hypnotic sight. My cousin Mark remembers that people on their way to Pittsburgh would stop their cars on the other side of the river just to watch.



The greatest enemy of steel, oddly enough, is air. Because oxygen is constantly trying to bind with iron to create the permanent orange layer better known as rust, steel had to be coated to keep out moist air. Products intended for outdoor use could be given a galvanic shield. This essentially meant plunging the steel into a bath of molten zinc at about 850 degrees. The zinc would bond to the surface of the steel, forming a series of layered zinc-iron alloys. When done properly, these alloy coatings last decades.

Before World War I, during the violent work slowdowns and protests that gave rise to the big steelworkers union, Donora remained staunchly antiunion. (In 1919, it would be the only town to oppose the Homestead strike.) For being the consummate company town in its early history, Donora was rewarded with a zinc plant.

The new zinc works built in 1915 was one of the world's largest facilities at the time; it stretched for forty acres along the river and was out

of date the moment it opened. Its massive, horizontal coal-fired furnaces were already giving way to electrically powered plants that were less smoky and that did not create such quantities of toxic zinc fumes. The plant's smokestacks, moreover, were less than 150 feet tall, too short to propel their contents above the 600-foot hills around them. In 1933, after the plant had been firing for less than two decades, a Pennsylvania historian reported that bones from some old Native American graves had washed out of the hillside downwind of the zinc plant's plumes. The grass that held the earth in place had died off.

Working zinc was like coking, only worse. The zinc furnaces were so hot that you could see heat rising from them in rivulets of distorted light, like fun-house mirrors. At its peak, the Donora Zinc Works employed about 1,500 men, who enjoyed an average workday of just three hours and yet received the highest wages in town—this in an era before unions had entered the plants. There was some difference of opinion about why this was. The workers themselves used to say it was because they were so efficient that they could fill the ovens in three hours with as much raw material as could be processed in an entire day. Lynn Snyder, an historian who studied the town's pollution, maintains that zinc workers worked a three-hour day because nobody could have tolerated more time than that in front of the red-hot furnaces.<sup>1</sup>

Most of the plant's employees had emigrated from parts of Spain where their families had produced zinc workers for generations. They did not mix much with the rest of the townsfolk. One fellow who had worked in a zinc plant in the 1950s commented to me, "I was the only one in the workforce who could read or speak English. Most of the workers were under twenty-five. Few of them lasted very long." He described his last day in the plant: "Five guys had gone before me to shovel out the finished zinc. Each one of them keeled over, real sick, kinda pale, and nearly passed out. I was the sixth one in. I couldn't take it either. I left. Spent a week in bed and never returned. Not many ever made it to the age of thirty as zinc workers. I quit when I was twenty."

Zinc is one of those elements that the body needs in very small doses in certain forms, but zinc can be poisonous in larger amounts and other forms. When bound with sugars in microdoses, zinc probably fights colds by killing rhinoviruses. When combined with gases of sulfur, carbon, flu-

oride, or nitrogen, zinc can be exceptionally dangerous. And it was not the only poison rising from those ovens. Zinc smelting and steelmaking both use lots of fluorspar, a rock made of crystals of fluorine tied with calcium. During smelting, fluorspar creates a penetrating and corrosively toxic fluoride gas that can eat the gloss off light bulbs, etch normal glass, and scar the teeth of children. One investigator found that mottled teeth, characteristic of fluoride poisoning, were common in Donora. My father had teeth like that. We figured he simply hadn't brushed enough as a kid.

Fumes from the mills, coke ovens, coal stoves, and zinc furnaces were often trapped in the valley by the surrounding hills. They gave us astonishingly beautiful sunsets and plenty of barren dirt fields and hills to play on.



On calm, cloudless, dry nights, the air gives up its heat to the surrounding hillsides, and growing denser as it cools, flows downhill like water. Usually, the temperature within any column of air is cooler the higher you get. Where there are valleys, the colder air from the hills can create an inversion layer that keeps warmer air from rising. Hot-air balloons fly because hot air is lighter than cold air. But when an inversion happens, balloons cannot fly, smoke cannot rise, and fumes, hot when released, cool and sink back to the ground, unable to dissipate.

October 26, 1948, brought a massive, still blanket of cold air over the entire Monongahela Valley. All the gases from Donora's mills, furnaces, and stoves were unable to rise above the hilltops and began to fill the homes and streets of the town with a blinding fog of coal, coke, and metal fumes. At first, cars and trucks tried to creep along with their headlights lit, but by midday, traffic came to a standstill as drivers could no longer see the street. "I could not even see my hand at the end of my arm," recalls Vince Graziano, then a strapping young steelworker. "I actually could not find my way home. I got lost that day."

Later, Berton Roueche, *The New Yorker's* distinguished medical writer, described it this way:

The fog closed over Donora on the morning of Tuesday, October 26th. The weather was raw, cloudy, and dead calm, and it stayed that way as the

fog piled up all that day and the next. By Thursday, it had stiffened adhesively into a motionless clot of smoke. That afternoon, it was just possible to see across the street. Except for the stacks, the mills had vanished. The air began to have a sickening smell, almost a taste. . . .<sup>2</sup>

Arnold Hirsh, a World War II veteran then just beginning his half-century as the town's leading attorney, watched the gathering fog from his Main Street office: "The air looked yellow, never like that before. Nothing moved. I went over to Seventh Street and stood at the corner of McKean, looking down towards the river, and you could just barely see the railroad tracks. Right there on the tracks was a coal-burning engine puffing away. It issued a big blast of black smoke that went up about six feet in the air and stopped cold. It just hung there, with no place to go, in air that did not move."

The sturdy people of Donora were not perturbed. On Friday afternoon, the town's annual Halloween parade took place under a spooky haze. Children's costumes appeared and disappeared in the mist as the parade moved the two blocks down Main Street. My mother remembers it as a ghastly sight, but it fit the occasion. "Of course we all went," she told me later. "This fog was heavy, but there was only one Halloween every year. Only this time we could not see much." People could not see their own feet. Within days, nearly half the town would fall ill.

Donora did not abandon its routines easily. The high-school football team, the Dragons, practiced kickoffs on Friday in preparation for the next day's home game against their great rivals, the Monongahela Wildcats. At the practice, Jimmy Russell, the head coach, had to yell "Kick!" so that the receiving players would know the ball was in the air. He had no idea that some boys had taken advantage of the fog and left early.

The football game between Donora and Monongahela went off on Saturday as scheduled. The entire town turned out for pep rallies and parades, with strutting drum majorettes leading the black-and-orange-uniformed marching band. The spectators often lost sight of the ball and could only guess from the referees' whistles when to cheer. Donora's star tight end, Stanley Sawa, was ordered by the public address system in

midgame to "Go home! Go home now!" Some in the stands thought it was a prank.

Still in his uniform, with his helmet in his hands, Sawa raced up and down the hills to his family's home at the bottom of Fifth Street, one of the many streets that were so steep they had stairs instead of sidewalks. He dashed into the house.

"What's going on?" he huffed. "Why'd you make me leave the game?"

"It's your dad," a neighbor told him.

"What are you talking about?" Sawa demanded. "Where is he?"

"In there, with the doctor," came the reply. "It doesn't look good."

The elder Sawa, who had earned his living lifting massive loads of iron ore, lay at home, short of breath, dizzy, thinking he only needed to lie down. By the time Stanley arrived home, his father had already died.

Monongahela won the game, 27 to 7. Spectators leaving the field later learned that by ten o'clock that Saturday morning, nine people had died. Within twenty-four hours the number would be up to eighteen.

Arnold Hirsh had tried to attend the game: "My brother Wallace and I decided we would walk up the Fifth Street steps. . . . We had just gotten out of the service. He had been a lieutenant in the navy, and I had been an infantry officer. We were both in as good shape as you could be. When we finally got to the top of those steps on our way to the game, we simply could not take another step. We did not say another word to each other. We could barely talk. We turned and headed straight home."

When they got there, they found their mother in distress. "My mother, who had not been well for years, just could not catch her breath," Hirsh recalled. Donora had eight doctors at the time, all of whom made regular house calls. This time, however, no one would come. "I called Doc Rongaus and he said that he just could not make it. He said, 'The whole town is sick. Even healthy fellas are dropping. Get your mother the hell out of town!'" The Hirshes drove into the Allegheny Mountains, away from the fog. Arnold's mother had come to Donora in 1920 as a healthy teenage bride. Both her parents, who lived elsewhere, survived to almost one hundred. By the time her two children were grown, she was an invalid with a weak heart and serious

breathing difficulties. She died two years after the smog, having barely reached her fifties.

Doc Rongaus gave the same advice to anyone who would listen: Leave if you can. The firemen of Donora went from door to door delivering whiffs of oxygen from tanks to those who were stranded. One of the firemen, John Volk, remembered borrowing oxygen canisters from the Monongahela, Monessen, and Charleroi fire departments. "There never was such a fog. You couldn't see your hand in front of your face, day or night. Hell, even inside the station the air was blue. I drove on the left side of the street with my head out the window, steering by scraping the curb."

When I visited him in 1999 at an old age home, Doc Rongaus told me that folks who made it to Palmer Park seemed to recover. The park sat high on a hill and was one of the few green places near the town, probably because the fumes from the mills did not regularly sweep over it. "My brother and I hauled women and children in horse-drawn wagons up to the park," he said. "Soon as we got them above the smog, they would get much better." Church ladies from nearby towns provided food and blankets to the involuntary campers.

Others shut themselves in. "I had an elderly aunt and uncle," Hirsh recalled, "who lived on the corner of Fourth and McKean, named Myerson. My aunt looked out the window and figured out that this was something pretty bad. She closed her doors and kept them closed. They had no problem at all. They just stayed inside for five days."

The folks who ran the mills stuck to their routine. The whistles that kept the daily rhythms of the town shrieked on schedule, and the shifts that kept the plants running day and night did not cease. Although many people whispered that the mills had put something strange into the air, the superintendent of the zinc works, Michael Neale, knew that his mill was doing nothing unusual.

It was Walter Winchell, with the voice that resonated importance and certainty, who made Donora famous. "Good evening, America!" he said in his national radio broadcast that Saturday night. "The small, hard-working steel town of Donora, Pennsylvania, is in mourning tonight, as they recover from a catastrophe. People dropped dead from a thick killer fog that sickened much of the town. Folks are investigating what has hit the area." But he had already given the answer many would come to accept: It was a "killer fog," a freak of the weather—ultimately, an act of G-d.

That weekend, the enormous volume of telephone calls created a five-hour wait before frantic relatives could speak to local residents. Roger Blough, then chief counsel of American Steel and Wire and later its CEO, finally reached Neale at three o'clock Sunday morning to tell him to dead-fire the furnaces, without zinc ore. A zinc furnace, like a coke oven, cannot be allowed to stop; once cooled, it can never be restarted. Dead firing—that is, keeping the fire very small—would protect the equipment while reducing the plant's emissions. Resentful of the interference and unconvinced that there was a problem, Neale only complied after a group of company-hired chemists arrived at six that morning, three hours after he had received the order to reduce operations. He described this action as a gesture of concern for the community, not an admission of responsibility for the smog. As he later told the press, "the zinc works has operated for thirty-two years with no problem."

By the time the fog began to ebb that Sunday, the local funeral home had run out of caskets. The basement of the community center, where the Brownies, Cub Scouts, Girl Scouts, and Boy Scouts usually met, became a temporary morgue. The *Pittsburgh Post-Gazette* reported, "the citizenry maintained an attitude of outward calm which was surprising to observers. . . . Here and there on the streets the youngsters continued their games of touch football and rode their bikes." Rains early on the morning of November 1 washed the skies of whatever had hit the town. By November 2, the zinc mill was again running at full steam. The same work ethic that kept the football team practicing, the marching band playing, and the cheerleaders cheering also got the town right back to work.

Roueché wrote,

Funeral services for most of the victims were held on Tuesday, November 2nd. Monday had been a day of battering rain, but the weather cleared in the night, and Tuesday was fine. "It was like a day in spring," [funeral director] Schwerha says. "I think I have never seen such a beautiful blue sky or such a shining sun or such pretty white clouds. Even the trees in the cemetery seemed to have color. I kept looking up all day."<sup>3</sup>



The day after the funerals, Joseph Shilen, a county medical official, filed a report with the Pennsylvania secretary of health, recommending that the zinc works be reopened. The incident, he wrote, was unlikely to recur. Asked to investigate the smog, John J. Blumfield, deputy head of industrial hygiene for the Public Health Service, refused to do so, calling it "a one-time atmospheric freak."<sup>4</sup>

What happened in Donora was not freakish, nor was it the first time that winds and weather combined with industrial fumes to kill so many that the deaths could hardly be counted. Neither Donorans nor many others knew that in 1930, in the Meuse River valley of Belgium, dozens of people had died within days in a smoky fog. Here, too, the exact count was never tallied. Like Donora, the Meuse Valley sat on a series of steep hills around a river valley, surrounded by metal mills and smelters. The conditions were similar: heavy fogs, lots of fumes from the mills, and workers who depended absolutely on the mills to feed their families.<sup>5</sup>

Some experts who studied the 1930 Meuse disaster six years later warned of the consequences if a similar catastrophe were to befall a larger city. Given the size and age distribution of Meuse's population, they calculated that if the same conditions ever hit London, more than four thousand people would die in a single week. Nobody listened.<sup>6</sup>

One Belgian investigator painstakingly demonstrated that fluoride gases were the likely cause of the devastation. Sulfur, he pointed out, in heavy doses leaves distinct marks on the linings of the lungs, but fluoride gases do not. They pass right into the bloodstream and attack the heart and other organs, without marring the nasal passages, throat, or lungs. The lungs of those who died in Meuse were clean. Nobody noticed.



The work of epidemiology is easiest whenever exposures are deliberate and controlled and take place over relatively short periods. The gold standard for epidemiologic research is the randomized, controlled trial of pharmaceuticals or surgical techniques. Under this system, people with similar personal characteristics, age, weight, height, medical histories, and so forth, are assigned to be given the test intervention or not, and their progress is carefully charted and tracked. Those who test drugs

in this fashion have the luxury of studying controllable, easily identifiable causes intended to produce known effects. They can set up studies that ensure that a given result reliably comes from the intended source.

The world in which we live and work is not such an easy or elegant place to study. When it comes to studying the impact of the environment on health, epidemiology remains an inexact instrument. In contrast to the precisely metered world of clinical trials of drugs, the environment in which people actually live is complex, unyielding of its secrets, and generally uncooperative. People outside of these controlled trials seldom know what they've been exposed to even recently, let alone in the critical weeks just before and after their birth. Getting accurate long-term-exposure data is even harder.

Most often, we fail to find solid answers. It took fifty years of finding unmistakably higher levels of sickness and early death in smokers for us to reach the conclusion that cigarettes really are bad for you. Our track record on environmental effects on health is especially unimpressive. As one of my colleagues remarked, "an epidemic is something so obvious it can be detected even by epidemiologists."

There are many reasons for these failures. What we do is genuinely difficult. Epidemics, which are by definition brief and localized, sometimes end before anybody can come in to study them. Sometimes we don't ask the right questions, or we ask them in such a way that the answer remains unobtainable. Even worse, sometimes the right questions are asked and even answered, but the news remains locked away in someone's private files or is written so abstrusely, and published so obscurely, that it might as well not exist at all.

For Donora, as for Meuse, the important questions never got asked. Information critical to figuring out what went on remained hidden, sometimes in full view. As a result, the right things never got counted.



After the smog, a brief campaign erupted against the zinc mill, led by folks outside of Donora. Abe Celapino, a prosperous farmer and restaurant owner from across the bridge in Webster, whose cows and chickens had died, joined forces with the *Monessen Daily Independent* in calling for

the mill to be relocated to a desert area. The editor in chief remarked that this might soon be unnecessary: The mill was creating its own desert area where it stood. Dr. Bill Rongaus, then the only member of the Donora Borough Council who was not employed by the mills, pointed out that the zinc mill was likely to account for the sudden sickness. "There was fog in Monessen, too," he told the Donora Board of Health, "but it didn't kill people there the way this did. There's something in the air here that isn't found anywhere else." Celapino alleged that Michael Duda, a zinc worker and borough council member, had told him late one night in Celapino's restaurant, "I've got a darn good job and I'm going to keep it. I don't care what it kills."<sup>7</sup>

In the month that followed, calls for major studies of the town were rebuffed by people who did not want to know the answer and by others who feared what it would ultimately mean for the town's workforce. It was revealed that the town council and the Chamber of Commerce had requested advice from the Pennsylvania Department of Forests and Waters the previous March. A reply from Deputy Forester James Cornely was read to a community hearing just after the smog had cleared: "It is my belief that Donora could demand that smoke filters could be placed in the smoke stacks of the zinc plant; and if done in the right manner with the suggestions of a possible usable precipitate or residue being produced, the result might be satisfactory."

This was an early suggestion for what later became standard industry practice. The escaping fumes contained valuable metals and other materials that could be trapped and reused, netting the mills more money and the town less pollution. But the mill operators in Donora had no interest in such a device.

The steelworkers union, not realizing it was putting jobs at risk, offered \$10,000 for a study that would explain the sudden deaths. The study, though delayed for two months and begun only after the mill had switched from coal to natural gas in some critical departments, was suitably ambitious. The first folks in were the medical experts. In a massive effort, nurses armed with questionnaires surveyed half the homes in Donora. Then the pathologists mounted an intensive study of the twenty who had died during the fog itself. The doctors conducted all the usual clinical tests. They looked into each lung, each

heart, and every other tissue that could be stained and assembled. A preliminary report by the Public Health Service, full of details of blood tests and other procedures and illustrated with copious x-rays and slides of lung tissue, came out within a year, but no final report followed. The detailed medical histories the nurses gathered have never been found.<sup>8</sup>

One eyewitness report from a medical expert paints a convincing picture of fluoride gas poisoning. "Listening to the affected chest, nothing could be heard. Occasionally inspiratory and expiratory wheezes would be heard in the asthmatics, but in the healthy chest nothing at all. It was as though the respiratory apparatus was paralyzed. Many were cyanotic [blue] and apprehensive not knowing what had happened." This expert did not identify a cause, but he could easily have been describing the clean lungs of the victims in the Meuse Valley.<sup>9</sup>

A Philadelphia chemist brought in to study the problem, Philip Sadtler, speculated that the toxin came directly from the mills. Within months of the disaster, he reported that he had found over 1,000 parts per million of fluoride in an air-conditioning unit from Donora. Blood taken from those who died showed twelve to twenty-five times the normal levels of fluoride.<sup>10</sup>

Their lungs, Doc Rongaus recalled some fifty years later, often looked fine at autopsy. A report issued by the commonwealth of Pennsylvania corroborates his memory, especially in its description of the person identified as Case P:

The evidence . . . discloses that the larynx, trachea and bronchi of the first order were little affected. Apparently, the irritating agent was carried into the lung and exerted its primary effect upon the terminal bronchi, the bronchioles and the pulmonary parenchyma. . . . However, the agent must have had a low irritating capacity since none of the cases exhibited a degree of hemorrhage, oedema, or necrotizing process commonly associated with the inhalation of lethal irritating substances.

\* [Analogy might be made here with certain war gases. Phosgene, for example, has little effect upon the upper respiratory tract. The finer bronchi and lungs undergo intense oedema and congestion during the acute phase of the poisoning.<sup>11</sup>

In other words, the body's upper breathing system was not disturbed by the air in Donora. Whatever killed these people slipped deeply and directly into the body, making a bloody swollen mess of the lower lungs, much like phosgene, a nerve gas used in World Wars I and II.

The source of the poison in Donora was never identified. The lethal smog spawned an entire new academic profession, focusing on the study of humans exposed to polluted air. The Public Health Service was charged with analyzing, assessing, measuring, and confirming what had happened. Donora was investigated to death—not because so many studies were done but because the absence of definitive evidence of air pollution's harm was taken as proof of its safety.

The few investigators who warned that all this was not merely bad weather were dismissed. About a year after the inconclusive Public Health Service report was issued, a remarkably candid critique of the report appeared in *Science* magazine on January 20, 1950. Clarence A. Mills, a physician from the University of Cincinnati, had been trying for some years to generate support for studying the conditions of the Monongahela Valley. He wrote that just two years before the disaster, there had been no interest in such research. Now he asked: "Just what did their year's work, with a staff of 25 investigators show?"<sup>12</sup>

The answer was, pitifully little:

The most valuable part of their year's work—analysis of poison output from the steel and zinc plant stacks—remains unused and unevaluated in their written reports. They spent months analyzing the valley air for poisons, but failed to calculate the concentrations probably present during the killing smog a year ago, when an inversion blanket clamped a lid down over the valley's unfortunate people. Had they made such calculation, they would have found that even one day's accumulation of the very irritating red oxides of nitrogen from the acid plant stacks would have caused concentrations almost as high as had been set as the maximum allowable for safety of factory workers exposed only for an 8-hour work day. At the end of 4 days of last year's blanketing smog, concentrations reached were probably more than four times higher than the 10 milligrams per cubic meter of air listed as the upper limits of safety! And

the Donora people breathed the poisoned air not 8 hours a day but for 4 whole days.<sup>13</sup>

Mills noted the eerie and tragic parallels between Donora and Meuse, where nearly identical conditions created lethal brews involving low-lying mill towns and zinc and steel fumes. And he challenged the claim that the Public Health Service had opened up a new field of inquiry, charging the organization with ignoring years of work by others:

Let us hope that the Donora tragedy may prove such an object lesson in air pollution dangers that no industrial plant will feel safe in the future in pouring aloft dangerous amounts of poisonous materials. Let us hope that the Donora disaster will awaken people everywhere to the dangers they face from pollution of the air they must breathe to live. These 20 suffered only briefly, but many of the 6000 made ill that night will face continuing difficulties in breathing for the remainder of their lives. Herein lies the greater health danger from polluted air—continuing damage to the respiratory system through years of nonkilling exposure.<sup>14</sup>

It has a strange ring to it, "years of nonkilling exposure."

The Public Health Service did not agree that the zinc works played any important part in the deaths. Despite independent tests showing that even sixty days later, air concentrations of fluoride gas were ten times what was then considered safe, the health service team made no measurements of fluoride levels for itself and did not mention the possibility of fluoride poisoning in its preliminary report.

In Donora, efforts to link the disaster to fluoride fumes and other metal fumes were fiercely contested. The Pennsylvania Department of Forests and Waters had complaints on file from farmers downwind of the zinc mill dating back to 1915, but the Chamber of Commerce, according to Doc Rongaus, saw that these reports never surfaced. Michael Neale, as leader of the Chamber of Commerce and head of the plant that emitted more fluoride gases than any other, was apparently determined not to endanger his production goals just because some folks had gotten sick.

And Donora seemed to side with Neale. Even as citizens from surrounding areas urged that the smog serve as the impetus for cleaning things up, no serious support for this position arose within the town itself.

I asked Rena Hirsh, Arnold's wife of half a century and a town resident for all of their married life, what she knew about the studies in Donora on people who had been "non-killed." "You'll have better luck finding a needle in a haystack than finding records of what really went on," she replied. "I don't know for sure. I might be wrong. But people really did not want to know what had happened."



It is possible to look without seeing. Once I went on a tented safari between Kruger National Park, Timbavati, and the Sabi Sand Reserve in Manyeleti, in Northeast South Africa. I sat in an open vehicle some twenty feet from a large clump of dry, beige bush on the savanna. The tracker whispered, "Look, there's the lion!"

I stared hard but could not see a thing. "He's right there!" the tracker insisted. Still I could see nothing. I thought the guide was playing with me. In front of me tan grass ran in all directions, broken only by occasionally larger clumps.

In the instant before the lion roared and charged at a speed I had not imagined possible, I managed to make out one dark eye. The cat pulled up about four feet from our jeep and slowly sauntered away. Lions, we were told, often bluff.

Looking without seeing is something others do. It took a charging lion to convince me that I might do it too—look at data over and over and not see what was right in front of me.

The first medical experts into Donora after the smog conducted all the proper clinical tests on the twenty who died right away. Following traditional approaches, they looked into each of the vital organs and all the other tissues that could be stained and assembled. They looked at each slide, each x-ray one at a time, and never put them all together. No one measured pollution in Donora until two months after the fatal smog had ended. As Mills noted, no effort was made to reconstruct

what had gone on during the episode itself. Worse, the experts never looked at the survivors. If they had, they would have learned that in the month after the smog lifted, at least fifty extra people had died.

The notion of "extra" deaths may seem strange. As my mother says, you only get one chance to die. But epidemiologists can, and routinely do, predict the number of people who should die in any given population in any given period, and thus can tell if a group of deaths is occurring that should not. These statistical patterns of dying are human lives with the tears removed, the literal bodies of evidence. In Donora, one of every three people got very sick during the week-long smog. Even a decade later, the town's death rate was much higher than in surrounding towns. But no attempt was made to link these deaths to the smog or to air quality in general.

The few results that did emerge were all published in the Public Health Service's preliminary (and, as it turned out, final) report of 1949. This report, which Mills found so lacking, now sits in the offices of the few people in the world who are concerned about the matter.

One of these is Robert K. Maynard, the adept and irreverent head of the Environment Program in central London. His idea of fun is to amass historical documents on interesting cases of pollution crises and their health effects. When he heard about my research on Donora, Bob showed me his collection of original maps of the area, lung slides, and other documents. "Here, you might find these amusing," he said, handing me a foot-tall stack of old reports and newspaper articles. "Let me know what you find out. It might come in handy. I could send you some photographs too if they'd be useful." I dreaded having to carry the stuff, but I did, and I accepted Bob's offer to send more. About a month later, a heavy package arrived, full of pathology reports, autopsies, and lots of official documents.

For two years, I sifted through these papers, over and over. When I finally found the key to Donora, it was something I had looked at countless times but never seen.

A simple black-and-white map shows the homes of each of the eighteen people who died in Donora between October 26 and 29, 1948, and the two who died shortly after. I transferred each death to a larger map that showed the hills and valleys, the streets and the mills.

These records had been sitting in various files for half a century. Plenty of people had turned their microscopes on each one of them, but nobody had stepped back to see the pattern.

It was not merely a sudden bad break of weather. It was foggy then, but the valley is still foggy in the fall today, and the fogs will continue for as long as warm river water emits vapor into colder air. What killed the people in Donora was what many suspected but could never prove. Most of the deaths occurred in the parts of town that sat just under the plume that spewed within a half-mile circle of the zinc mill.



Many events of the 1940s—Pearl Harbor, D-Day, the end of World War II—were commemorated with fiftieth-anniversary celebrations. The fiftieth anniversary of Donora's killer smog almost passed without notice.

Donora is a different place now. After the big strikes in the fifties, the massive, inefficient mills shut down, leaving the town to cope with deteriorating schools and a crumbling tax base. Many of the men, unwilling to give up the homes they had so painstakingly built (or unable to sell them) began commuting sixty or even a hundred miles a day to take jobs in other towns. The Monongahela, ever a poisonous brown, began to flow blue. "First they tore down the big plants," one resident recalled. "Then they built a McDonald's and no one came. So they boarded that up and built a parking lot. Now nobody parks there either." Main Street now has a single traffic light, a second one having been converted back to a four-way stop sign to save on maintenance. The former Hotel Donora, once home to dozens of bachelor mill workers and the town library, is a martial arts training center and occasional rooming house.

On one of those lovely spring days when the meandering Monongahela basin looks impossibly green, Arnold and Rina Hirsh walked with me up to the small, neatly kept Jewish cemetery where my grandparents are buried. It sits atop one of the prettiest bluffs in the area, with a panoramic view of the rolling river valley. The Hirshes, Sammy Baylis, and Herman Weiss keep the place locked and tidy, with small gray headstones recalling Donora's former residents and waiting for the few who

remain to join them. "You see the beautiful trees and beautiful view we have today?" Arnold said to me. "There was nothing here for many years after the smog was over. There was nothing but clay on that hillside."

In 1998, just about the time of the fiftieth anniversary of the disaster, an earnest high-school student named Justin Shawley got a monument set up. The Pennsylvania Historical and Museum Commission erected a five-foot-square bronze plaque near the center of the former steel mill as a memorial to those who died. To mark the occasion, residents and local and state officials held a service at Our Lady of the Valley Catholic Church, one of Donora's few remaining houses of worship. The plaque says:

#### *The 1948 Donora Smog*

Major Federal clean air laws became a legacy of this environmental disaster that focused national attention on air pollution. In late October of 1948, a heavy fog blanketed this valley, and as the days passed, the fog became a thick, acrid smog that left about 20 people dead and thousands ill. Not until October 31 did the Donora Zinc Works shut down its furnaces—just hours before rain finally dispersed the smog.

It is a touching monument. The fifty people who died in the month following the smog are nowhere counted. The thousands who died over the following decade are nowhere counted. And there is no counting of the thousands whom Clarence Mills called the non-killed—all those who went on to suffer in various poorly understood ways. Standing there by the ruins of the old mill, I thought I understood, just a little, what Sol Filler must have felt on revisiting Tereisenstadt: These people are well intentioned. They are trying to commemorate, to remember, to atone. But they are not trying hard enough.

Every one of Bubbe Pearl's five children developed heart problems. None of their illnesses would ever be tied to where they grew up. They are not listed on any memorial to Donora's dead. In 1969, my dazzling, athletic Uncle Len dropped dead at age fifty on a handball court in Southern California, years and miles away from the Monongahela River Valley. But he carried Donora with him in his heart—and in other body tissues as well. By the time my mother reached the same age, a decade

later, coronary artery bypass operations were available to keep her alive. She needed three of them. Aunt Gert required only two angioplasties.

Bubbe Pearl's tombstone sits in the lovely Jewish cemetery with its spectacular view of the river valley. When I was born, she was still a fierce driver, but by the time my brother arrived, a year and a half later, she had become an invalid. She did not die during the smog of 1948 either—the town erected no plaque for her—but only some two dozen heart attacks later. The attacks were so common that they became almost a ritual. The room would go quiet, and my mother, the baby of the family, would steady her own mother by the arm and steer her to the bed. The heavy, mottled-green, steel oxygen tank would be wheeled over, the valve turned on, and the gas mask pulled over Bubbe's nose and mouth. Her skin often matched the blue-white color of her hair.

Aunt Gert, the oldest sister, always had to leave the room, unable to stand by helplessly while her mother fought for air. Sometimes Bubbe would shriek, "*Oy vey!*" But usually there was silence, and sighing. We would all wait for Dr. Levin. Dr. Levin always came, always calm, always sure. His arrival meant that everything would be all right.

The night she finally died, he did not come. I could not stop crying. I had seen her nearly die so many times, I was sure it was a mistake.