Blaine Harden

A River Lost

THE LIFE AND DEATH OF THE COLUMBIA

"Superbly reported and written with clarity, insight and great skill."
—T. H. Watkins, *Washington Post Book World*

Blaine Harden A River Lost

NORTON

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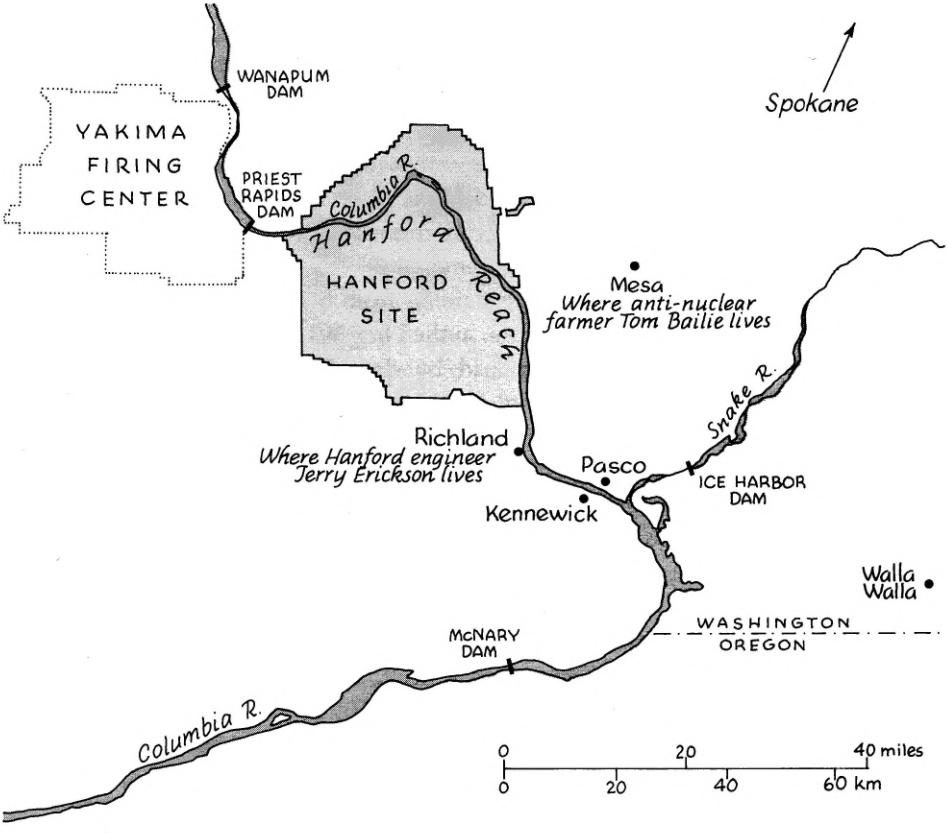
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Wild and Scenic Atomic River

As they seek to become the world's leading experts in solving waste problems, the men and women at Hanford will help make a cleaner, safe environment for everyone everywhere.

—***The Hanford Story***
a children's coloring book printed for the fiftieth anniversary of the Hanford nuclear site

THE RIVER THAT arcs around the edges of the plutonium factory is not the bathtub Columbia that we have come to expect, all fat and listless and stoppered up behind concrete. On the contrary, this stretch of river is swift, undammed, exuberantly wild. Shallow water scuds over gravel bars where chinook salmon spawn by the tens of thousands. Bald eagles swoop to capture spawned-out fish. Pregnant deer fight the current as they swim out to islands in the river to fawn at a safe distance from coyotes. Great blue herons nest in apricot trees along the shore. A dun-colored desert plain rises gradually from the right bank of the river, climbing three thousand feet to a distant basalt spine called Rattlesnake Mountain, where river Indians once sent their sons to pray alone to the Creator. Between the fast river and the sacred mountain, amid a covering of sagebrush and bluebunch wheatgrass, about fifty species of wildlife take refuge. From pygmy rabbits to Rocky Mountain elk, the plain is one of the last sanctuaries in the Pacific Northwest for endangered and threatened wildlife. On the river's left bank, a sheer bluff of creamy white clay juts up six hundred feet, containing within its sun-bleached verticality the fossilized remains of rhinoceros and camel, mastodon and

bear. Prairie hawks, peregrine falcons, and other raptors rifle down out of the mausoleum bluffs to prey on migrating ducks and geese.

The Hanford Reach of the Columbia is not unlike the "incredible" river that awed Lewis and Clark in 1805. For fifty-one miles, it surges through an arrestingly uncivilized landscape, cantankerous as its ancient self. As the only free-flowing, non-tidal segment of the river in the United States, it offers salmon the finest spawning habitat on the Columbia and is the best reason to believe that wild salmon will never be completely engineered out of the river. The Hanford Reach, which cuts through the only extant shrub-steppe ecosystem in eastern Washington, has been recommended by the Department of the Interior as a wildlife refuge and a National Wild and Scenic River.

This curiously undead fragment of the Columbia, of course, is an accident. The Hanford Reach eluded dam builders not because it was exceptionally scenic but because it was eminently expendable. The Manhattan Project, the U.S. effort to develop an atomic bomb during World War II, knew little and cared less about rivers or salmon. Frantic to beat Hitler to the bomb, a substantial factory site was needed for the production of weapons-grade plutonium, a process that demanded huge quantities of cold water and electricity. After a nationwide search, the bomb makers settled on the tiny riverside village of Hanford because the surroundings offered access to the nation's coldest big river and power from the world's biggest dam. But even more important, in the words of Franklin T. Matthias, the Army lieutenant colonel who in 1942 scouted locations for a plutonium plant, Hanford was "an area with almost no people." There would be few victims—or witnesses—in case the biggest secret of World War II happened to blow up.*

The army ordered the few hundred farmers and fruit growers who lived in and around Hanford to get out within thirty days. It bought up about six hundred square miles of what it considered to be wasteland and sealed it off behind barbed wire and machine-gun-

*The U.S. Army ruled out Oak Ridge, Tennessee, as a site for the huge plutonium factory because, as General Leslie R. Groves, head of the U.S. effort to develop an atomic bomb, put it, if a "reactor were to explode and throw great quantities of highly radioactive materials into the atmosphere when the wind was blowing toward Knoxville, the loss of life and the damage to health in the area might be catastrophic."

toting men. Federal authorities in later years vetoed a proposed dam for the Hanford Reach, it being poor public policy for the river to back up over America's largest depository of radioactive crud.*

As the decades went by, an astonishing thing happened behind the high-security fence at Hanford Engineering Works. While the plutonium makers were spilling 440 billion gallons of contaminated liquid into the sandy soil (enough to flood Manhattan to a depth of eighty feet) and sowing the seeds for what the Energy Department calls "the single largest environmental and health risk in the nation," they inadvertently invented a post-nuclear paradise.

The Hanford Reach emerged from the cold war as a wild and scenic nuclear dump, a sanctuary for endangered species and toxic waste, a spawning ground for healthy wild salmon and a burial ground for hydrogen-belching plutonium sludge that can kill on touch. It is a fine place to see an eagle hunt, deer graze, or fish spawn. But best not drink the groundwater for a quarter million years.†

The character of this aberrant Eden was neatly packaged in the summer of 1990 when a hell-raiser by the name of Norm Buske paddled a rubber boat along the Hanford Reach. Buske positioned himself just downstream from N Reactor, a giant decommissioned nuclear plant that for twenty years had pumped about a billion gallons of radioactive waste into two open trenches, one of which lies less than the length of a football field from the Columbia. An underground spring, affectionately called N Springs by plant workers, ran beneath the two trenches and dribbled into the river. Among the many unappetizing pollutants that were measurable in N Springs was strontium-

*Radioactive or not, dam builders from the U.S. Army Corps of Engineers were eager to seize and squeeze electricity out of this last wild stretch of the river. As recently as 1979, after Hanford had been in the plutonium business for more than three decades, the Corps organized a tour of the Hanford Reach to show how useful the proposed Ben Franklin Dam could be. "The unimpounded Hanford Reach represents a break in the total Columbia River hydropower system," tour literature said. "A dam and a reservoir on the Reach could provide an additional energy supply and improve the hydraulic efficiency of the entire Columbia River hydropower system." Ben Franklin Dam is now considered a dead idea.

†That is the half-life for the longest lived of the radionuclides known to be shifting around in the uncontained aquifer beneath Hanford. The aquifer discharges to the Columbia.

90, a highly carcinogenic radionuclide with a half-life of three hundred years and a penchant for seeking out and lodging in human bone. The concentration of strontium-90 in N Springs was, at the time of Buske's rubber-boat adventure, about nine hundred times higher than the federal standard for safe drinking water.

In the rubber boat that day, Buske, by training a physicist and by avocation an anti-nuclear troublemaker, knew where N Springs was and what it contained. What he had not expected to find, on the shoreline and washed in the nightshade seepage of N Springs, was a crop of perfectly ripe mulberries. Inspired by their juicy pulchritude, he paddled up to the west bank of the river, picked a quart of berries without getting out of his boat (which would have been a violation of federal law), and rushed home to make jam. He mailed his jam, along with a letter, to the governor of the state of Washington and to the secretary of energy. The letter said: "This mulberry jam is a token of the future hazard of unidentified, uncontained, and unmanaged radioactivity at Hanford."

So it was that two jars of ruby-red preserves triggered the mulberry syndrome.

Alarmed consumers swamped the Washington State Department of Health with questions about the safety of the state's celebrated apples and peaches. Agribusiness got angry. Politicians demanded action. The mulberries, in fact, were a very low-level risk. Buske told me he would have had to eat an entire jar of mulberry jam every day for a year before he would begin to worry about his health. But in the politics of nuclear fear, where paranoia is a given and distrust of the government runs deep, a nicely turned media perception usually outweighs scientific risk. Hanford workers, therefore, were ordered down to the river. Wearing blazing white radiation suits and armed with chainsaws, they mowed down every mulberry bush in sight, stuffing severed limbs and mashed berries into concrete coffins.

After three years of policy-option papers and mid-level bureaucratic waffling, the mulberry coffins were sent out on the road. They were trucked to Oak Ridge, Tennessee, to the nation's only certified incinerator for low-level radioactive waste. There, the bushes and berries were mashed, analyzed, cremated, placed in an urn, and

shipped back to Hanford for burial in a special pit designed for low-level waste.

The price tag for the perception that Buske so shrewdly ignited—for cutting, boxing, storing, shipping, burning, compacting, testing, reshipping, and burying the mulberries—exceeded two hundred thousand dollars. The price tag for stanching all radioactive dribbles at N Springs will be much, much higher. As part of an "Expedited Response Action," the government has hatched several multimillion-dollar schemes to prevent hot jam from ever again reaching the desks of higher-ups. One plan under high-level review would insulate the west bank of the Columbia from radiation by inserting refrigerant tubes in the sandy soil and freezing it solid.

The Hanford stretch of the river, ever since the federal government saved it by deciding it was expendable, has been a reliable source of astonishment.

The first surprise came on August 6, 1945, the day the first combat atomic bomb fell from an airplane. Called Little Boy, it exploded over the Japanese city of Hiroshima. Birds incinerated in flight. Telephone poles burst into flame. Human beings within a half mile of the bomb's hypocenter shriveled into smoking piles of ashes. "The corpse lying on its back on the road had been killed immediately. Its hand was lifted to the sky and the fingers were burning with blue flames," said a woman who lived to describe the work of Little Boy. The bomb killed about sixty-four thousand people, a quarter of the population of Hiroshima.

"IT'S ATOMIC BOMBS," screamed a banner headline in an extra edition of a Hanford newspaper on the day the bomb exploded. The Manhattan Project was out of the bag. President Harry Truman explained what nearly 150,000 workers had been building for thirty months at the "big war project" in the desert beside the Columbia. Except for a handful of physicists, engineers, and army officers, those workers had been as ignorant about the bomb as the Japanese.

It turned out that the Hiroshima bomb was armed with enriched uranium from Oak Ridge, not plutonium from Hanford. But just three days later, Hanford's handiwork hit the headlines and

lit up Nagasaki. That bomb, called Fat Man, killed about thirty-nine thousand people, some quickly, many others over time. Within two days, Japan began talking surrender. "PEACE! Our Bomb Cinched It," proclaimed a newspaper in Richland, the federally managed town that housed Hanford's engineers and technicians.

With World War II won, Hanford churned out the coinage of the cold war. It manufactured fifty-three tons of plutonium, more than 60 percent of the U.S. nuclear arsenal.* The arms race with the Soviet Union spelled a long, lucrative boom for the Tri-Cities of Pasco, Kennewick, and Richland, towns clustered just downstream from the plutonium factory. Richland, with more Ph.D.s per capita than any municipality in America, evolved into a wondrous company town, a prosperous mix of normalcy, secrecy, paranoia, and pride. Each cold war morning, teams of health scientists collected urine samples from the front porches of Hanford technicians. The FBI made yearly rounds, asking neighbor about neighbor. The main hospital in Richland was built with a nuclear-incident wing, where a monorail whisked patients exposed to radiation through a sort of car wash, hosing them down before doctors worked on them behind lead shields.

Richland sprouted Atomic Bowling Lanes, an Atomic Body Shop, Atomic TV Repair, even an "Atomic Man." He was Harold McCloskey, a technician who survived a 1976 accident at Hanford that sprayed his face with the largest human dose of radiation ever recorded. He became the most thoroughly studied nuclear victim in America. Baggies of his feces and urine (labeled "Caution Radioactive") were stored for years in laboratory refrigerators and freezers

*Plutonium, first identified in 1940 at the University of California in Berkeley, was named after the planet Pluto, which was named for the Greek god of the underworld, the lord of the dead. The synthetic element is the preferred fuel for bombs because it is highly fissionable, that is, easy to explode. Weapons-grade plutonium is made inside an atomic reactor, from natural uranium. After being separated from uranium by chemical means, it is molded into hockey-puck-sized "buttons" for use in bombs. While plutonium itself is one of the most poisonous substances known to man (a microscopic speck in the lungs can cause cancer), a nickel-plated plutonium button can be oddly comforting to touch. "When you hold a lump of it in your hand," wrote physicist Leona Marshall Libby, "it feels warm, like a live rabbit." Storing the live rabbit can be treacherous. Too much plutonium kept too close together can create a spontaneous "criticality," a deadly flash of radiation and heat.

across the Hanford site. After the accident, McCloskey was almost blind and his face could set off Geiger counters fifty feet away. But he was pro-Hanford until the end (of a heart attack in 1987). "Just forget about me being anti-nuclear, because I'm not," he said a decade after the accident. "We need nuclear energy."

Football players from Richland High wore a mushroom cloud on their helmets and called themselves the Bombers. The symbol of the atom was carved atop stone columns at the entrance to the cemetery. When liberated from federal ownership and allowed self-government in 1958, Richland's residents staged a simulated atomic explosion in a vacant lot on the edge of town. And when the cold war began to wind down, announcement of the closure of N Reactor brought mournful Tri-Citians into the streets by the thousands. They held candles and sang "Kumbaya."

Though Hanford lost its reason to exist, it did not lose its capacity to astonish. In 1986 when an environmental group in Spokane forced the release of classified documents from Hanford, the public learned that the plutonium factory had made a practice of poisoning its downwind and downstream neighbors. Huge atmospheric releases of radiation, all of them secret and some of them intentional, occurred throughout the second half of the forties and early fifties. Radiation drifted east with the prevailing winds across eastern Washington, Oregon, and northern Idaho. An alarmed army of "downwinders"—farmers and housewives, many of them irrigators from the Columbia Basin Project—queued up to sue, claiming thyroid disease, cancer, stillbirths, and birth defects.

Hot water from Hanford made the Columbia the most radioactive river on earth. River water was piped into eight reactors as a coolant, stored in basins for a few minutes or a few hours, and then pumped back into the river. The temperature of the Columbia went up by as much as 2 degrees as the river swallowed highly toxic radionuclides that found their way all the way out to the mouth of the river (more than 350 miles) to lodge in oysters and clams. Hanford documents show that biologists secretly discussed the "advisability of closing" a downstream stretch of the river to public fishing and hunting in the late 1950s when plutonium production was at its peak and resident fish and ducks showed dangerously high concentrations of

radioactive phosphorus. But no warnings were issued. The last of the primitive-technology "single-pass" reactors was shut down in 1971. To the immense relief of federal and state health authorities, the river diluted and swept away nearly all the contamination. The most susceptible victims of the "river pathway" turned out to have been the same people who were most susceptible to dams on the Columbia—Native Americans who ate a lot of fish.

Hanford's final astonishment (barring a catastrophic environmental accident) is the cost of cleaning up the mess. It may prove to be the most expensive environmental cleanup project in history. The bill was initially pegged at an astronomical $50 billion over thirty years. By some estimates, that could jump to $300 billion. By comparison, it cost $250 million to clean up Love Canal, $1 billion for Three Mile Island, and $10 billion to restore Kuwait's oil industry after the Gulf War.

Hanford is home to two-thirds of the country's high-level radioactive waste, some of it in tanks and some of it in the soil. The federal Agency for Toxic Substances and Disease Registry ranked Hanford as its top health hazard among more than a hundred major cleanup sites across the country. Because of the threat of explosion and the threat to groundwater, Hanford was the only site on the "most urgent" list.

Feasting on its "environmental mission," the Tri-Cities boomed in the early 1990s as never before. Total employment for the area's one hundred thousand inhabitants reached an all-time high. Unemployment reached an all-time low. The payroll at Hanford jumped to eighteen thousand jobs, more than a 70 percent increase over the peak plutonium-making years. Workers earned an average salary of forty-three thousand dollars. Home values soared, making the Tri-Cities the nation's hottest real-estate market. Sam Volpentest, head of the Tri-City Industrial Council, told the *Wall Street Journal* that "the green stuff is just raining down from heaven." It was falling so fast that about a third of it—$650 million in 1994, enough to pay for half the annual budget for the state of Idaho—was wasted, according to a cleanup chief at the Department of Energy. Classes in waste treatment at the community college overflowed with students, shopping malls bustled with shoppers, construction of new homes set an all-time record, as did automobile sales, and traffic clogged bridges

over the Columbia. A common bumper sticker on cars stuck in rush-hour traffic said: "Another environmentalist for nuclear power."*

For travelers on the Columbia, the Hanford Reach is an anomaly, a skinny irradiated thumb sticking out of the bloated continuum of the dammed-up river. Barges and irrigators and utility companies have been kept out. The politically volatile trade-off between salmon and commerce does not pertain. Since the reach was never fattened up by a dam, there was no fight over a reservoir drawdown. In its sick quarantined way, the Hanford Reach is too healthy to be part of the engineered West, too isolated to be muddied by the politics of the working river. Although I found myself spending more time around Hanford than any other part of the river, I did not quite know what to make of it.

Then one warm July night in Richland, at a crowded public hearing during which nuclear technocrats were floating a scheme to process more plutonium, the Hanford Reach snapped into focus.

What sharpened up the picture, amid the plastic chairs and fluorescent lighting of the windowless meeting room in the Hanford House Red Lion Inn, was a fog of intolerance. The crowd was choking on it. Most of the people attending the hearing that night worked at Hanford, and they welcomed the proposed restart of the aging plutonium finishing plant. It would be a hundred million dollars more gravy for the Tri-Cities, money that would trickle down to the assembled technicians, enabling them to redo their kitchens, take trips to Columbia Mall, save for college tuition. The locals nodded their heads approvingly as Hanford officials explained that an eighty-week "stabilization run" at the plant was needed to convert volatile plutonium scraps left over from the cold war into talcum-like powder that could be stored safely.

*The boom began to ebb in the mid-1990s. Regional newspapers, particularly the *Spokesman Review,* wrote eyebrow-raising accounts of profligate spending at Hanford, as well as the glacial pace of the actual cleanup. A U.S. Senate report in 1995, entitled "Train Wreck Along the River of Money," said that the $7.5 billion spent in six years at Hanford has produced almost no actual cleanup. The investigations combined with budgetary pressures in Washington to pressure the Department of Energy to begin cutting the cleanup budget.

Along with these locals at the meeting, there were a few outsiders—anti-nuclear activists from Seattle, downwinders from the East Side of the river—who had come to ask thorny questions. They seemed convinced that Hanford was again conniving to drizzle carcinogens into the air, the river, and the groundwater. Their manner suggested that everyone at Hanford was a war criminal. While the outsiders asked their questions, the locals stared in stony, resentful silence. Finally, when a long-winded Seattle environmentalist pressed for detailed answers about the disposal of the "waste stream" from the plutonium plant, a middle-aged Hanford worker in the audience could take it no longer.

"Shut up, you pup!" the man yelled, and the locals applauded.

It occurred to me, as I watched these westerners who detested each other, that the Hanford Reach, rather than being an aberration in the making of the engineered river, was its culmination.

The plutonium factory was the endgame for the New Deal on the Columbia. Federal domination that began in the 1930s with a well-meaning effort to create jobs at Grand Coulee had mutated into an interminable and ludicrously costly struggle to mop up lethal waste. There had been an inexorable slide from public-works projects that saved the common man to clandestine schemes that contaminated him. The final irony of federal domination was the river itself. The Columbia was at its free-flowing, salmon-choked best only when flowing past the Western world's largest and leakiest nuclear dump.*

Now that most of the secrets were out at Hanford and the cleanup was under way, the most enduring consequence of federal control in my home country was not pollution, but intolerance. It had taken firm root during a half century of lies and secrets. Nobody had known anything about what was going on out at Hanford, nobody had a right to know, and nobody was inclined to complain

*The relative health of the Hanford Reach, as far as fish and wildlife are concerned, is a function of a half century of isolation from farming, suburban sprawl, slackwater, and other development. Wildlife on the site has, on occasion, been measured with dangerously high levels of radiation. But, in general, all species of fish and game have prospered. Radiation in the river, which is diluted by the enormous flow of the Columbia, does not appear to have had any deleterious effect on salmon. The fish, of course, spend the bulk of their lives in the Pacific Ocean, far from N Springs and Hanford's other riverside delights.

because, as the head of the Tri-City Industrial Council so aptly put it, the green stuff was just raining down from heaven. In the democratic vacuum, Hanford created another accidental and pernicious by-product: a binary society. Technicians versus hayseeds. Believers versus victims. Separated by the river, they had come to see each other as nothing less than murderers and fools.

My little epiphany in the Red Lion Inn came after I had made the acquaintance of two men, a believer and a victim, who live on opposite sides of Hanford Reach. They had never met, yet they loathed the very idea of each other. Each man showed me his version of Hanford and warned me not to believe what I might hear from the mendacious simpletons on the other side of the Columbia. They were both likable and open and noisily good-natured in the way that westerners are so proud of. Except, of course, when they talked about the enemy across the river.

"Did you ever see the movie *Deliverance?*" Tom Bailie, the downwind victim, asked me at our first meeting. "You know, those Appalachian squirrel hunters, those retarded in-bred guys with funny looks on their faces. Well, the cast of *Deliverance* is living in Richland and working at Hanford to this day."

In Richland, Jerry Erickson, an electrical engineer who has devoted most of his professional life to N Reactor, told me that the downwinders are a sad symptom of a poorly educated nation.

"It is just a matter of ignorance," said Erickson, whose three sons all work in the nuclear industry, two of them at Hanford. "I think our society is technologically in the dark ages. These people think Hanford is like some kind of science-fiction movie. I don't understand a public that can be led down such strange alleys."

The gulf between believers and victims shows up clearly in public-opinion surveys. Three-quarters of eastern Washington residents do not believe the government has been honest about Hanford's dangers, according to a 1994 survey by Washington State University. Two-thirds of those surveyed believe Hanford will damage the health of their grandchildren. Residents of eastern Washington are as skeptical about Hanford, the study found, as Russians are about Chelyabinsk-65, that nation's dirtiest nuclear site.

Across eastern Washington, the exception to this opinion is in the Tri-Cities. The closer people lived to Hanford's paychecks, the

less skeptical they were of the government. A reader's poll in the *Tri-City Herald,* the region's dominant daily newspaper, suggests that Hanford's believers are upset not at the federal government but at the downwinders who claim to be Hanford's victims. Asked if the government should pay compensation to downwinders affected by radiation from the plutonium factory, nearly 60 percent of respondents said no.

Jerry Erickson, the engineer at Hanford, arranged to take me on a tour of his life's work. He had come to Hanford in 1959 because he liked to "build stuff." He now has seven patents on instruments he invented for N Reactor.

"For a technical person, when you build stuff, it is candy," Erickson told me. "From a technical point of view, Hanford has been a candy shop. I have put bread on the table and raised my kids in a very healthy environment and I am proud to say that I have had a wonderful technical time."

Erickson, sixty-four years old when we met, is a tall, skinny, hyper-energetic man who wears horn-rim glasses and whose left shirt pocket bulges with pens and scribbled drawings of projects in progress. He bears a passing resemblance to what Jerry Lewis might have looked like had he, like Erickson, been a lifelong jogger. The engineer's youngest son, Tim, also an engineer, told me that his father "can't sit still. If you give him a present, he will take it apart before he uses it." When Jerry Erickson installed an underground sprinkler system around his Richland house, he made drawings and a plastic mockup to gauge sprinkler overlap at different wind velocities in his yard. He made a paper mockup to determine if his wife's piano would fit in the basement. (It would, but it remains in the living room.)

Erickson is a fourth-generation northwesterner, whose forebears came West on the Oregon Trail. His great-grandfather, James Longmeyer, led a wagon train that briefly lost its way in what became the Hanford site. In his memoirs, he recalls camping on the empty desert in 1853 beside the Columbia River, just opposite the soaring White Bluffs and not far from the nuclear reactor his great-grandson would help build. Longmeyer was searching for a well-watered place

to settle, worried about Indians who kept tagging after the wagon train. "We placed a couple guards out, as we supposed they had led us into this trap in order to massacre our whole party," Longmeyer wrote. The Indians did not attack and Longmeyer's party wandered off to the southwest toward a less arid settlement on the Yakima River, a tributary of the Columbia.

Jerry Erickson grew up on a farm not far from the Yakima. A poor student, he excelled only in machine shop. His most vivid boyhood memory is of assembling, from a bucket of parts and without instructions or adult help, a 1929 Harley-Davidson motorcycle. A neighbor had taken the bike apart for an overhaul, but could not figure out how to put it back together.

"I don't have any idea how I knew. I just knew, that's all. I was just inquisitive enough and I had enough ego."

After high school and apprenticeship as a tool-and-die maker, Erickson went into the Navy. He considered electronics "a sissy kind of a thing," but was pushed into becoming a specialist in flight simulators and other electronic training equipment. To his surprise and delight, he found he could compete with college-trained electrical engineers. After leaving the Navy, he enrolled in engineering school at the University of Washington. Once he had his degree, he was recruited by Philco in Palo Alto, California, where he helped develop a receiver for one of the first military satellites. However, he hated California.

"I came up to Yakima in 1959 to visit my family, and decided to drive over to Hanford [a distance of about fifty miles] to see what was going on. I stopped at the five-and-dime in Richland, called up the employment office at Hanford, and asked them if they needed an electrical engineer. They said, right on the phone, 'Don't move!' They rushed down and brought me back to the employment office. I didn't have a résumé with me, so they got me a secretary to take dictation. She typed it up right there. Boy, they were solicitous."

Erickson went to work designing instruments for N Reactor, then under construction as the largest of Hanford's nine riverside reactors. It was commissioned in 1963 as the country's first and only "dual-purpose" nuclear plant, capable of turning out both plutonium for bombs and electricity for a half-million people. President John F. Kennedy visited Hanford to dedicate the reactor and made a speech

about how it marked a turning point for the peaceful use of atomic energy. Erickson, his wife, Peggy, and their boys, along with thirty-seven thousand other Tri-Citians, trooped out to the reactor site to hear Kennedy describe Hanford as "a great national asset and I can assure you it will be maintained."

N Reactor, unfortunately, bore more than a passing resemblance to an unlucky nuclear plant in the Ukraine. It was called Chernobyl Number Four. When Chernobyl blew in 1986—in the world's worst nuclear accident—N Reactor became a public-relations embarrassment to the federal government.

The Hanford reactor resembled Chernobyl in that it was built out of graphite blocks, produced both power and plutonium, and lacked a containment dome to seal in contaminants in case of accident. Erickson and other Hanford engineers insisted that these similarities were cosmetic, and that N Reactor had a fundamentally safer design.

"We tried to explain why our plant was never going to have the same problems as Chernobyl, but nobody wanted to listen," Erickson told me.

N Reactor plant shut down in 1987 for a safety overhaul. The collapse of the Soviet Union in 1991 turned the overhaul into a mothball job.

In the cutbacks that followed, Erickson accepted what he calls a "very attractive retirement plan." It was so attractive, in fact, that N Reactor lost many of the senior engineers who understood the plant well enough to preside over its cleanup and dismemberment. The government had to go begging for expertise from old-timers. When I met Erickson, he was back working at N Reactor as a consultant, driving out to the Hanford site two or three days a week.

Security at the old plutonium factory has been sharply reduced since the collapse of the Soviet Union. The site is open to just about anybody who requests a guided tour. Delegations of journalists, anti-nuclear activists, even Russian physicists have been squired through nearly every building on the site, including the plutonium finishing plant, once a sanctum sanctorum of American national security. But Hanford remains closed to unescorted gawkers. Besides the potentially explosive underground waste tanks that are larger than the Capitol dome and the 1,400 or so radiation hot spots spread around the

site, vaults at Hanford house several tons of weapons-grade plutonium, perfect for terrorist bomb assembly.

To get past the security gate, I needed—in addition to Erickson's invitation—a security badge, a radiation-exposure badge, and an official guide from Westinghouse, the lead contractor on the site. We all met on a cloudless July morning in the parking lot of Westinghouse offices in Richland. Don Brauer, our garrulous Westinghouse tour guide, suggested that we go in his company car. Erickson insisted on sitting in the backseat.

We started the tour in Richland, a fastidiously tidy riverside town of thirty-two thousand people who live just beyond the southern tip of the Hanford reservation. Half of Richland's inhabitants are either managers or technicians. Nine out of ten residents are white. As we tooled through Richland's quiet, tree-lined residential streets, Brauer and Erickson competed with each other to praise the town as a comfortable and safe place to bring up children.

"Richland has more parks per capita than any city in this state," said Brauer. He pointed to Chief Joseph Junior High School, a gray concrete structure which he said was "the only junior high school in the world built to look exactly like a nuclear reactor."

"There is a mint F!" exclaimed Erickson from the backseat, pointing to a handsome two-story, three-bedroom house. All the houses in the older parts of Richland were built by the government in 1943–44 as homes for Hanford technicians. The "F" to which Erickson pointed would have been reserved for a senior manager, since it was close to the Columbia. Erickson lives farther from the river in a more modest "E," a one-story saltbox. Far larger than any room in his house is his garage, which the engineer designed and built and which he describes as "the best workshop in the neighborhood, the place where I keep all my toys and tools."

Beyond the security gates, where armed guards scrutinized my badge, my driver's license, and my face, Hanford opened up before us as a big spread of sun-drenched nothing. About 96 percent of the site, according to the federal government, has been untouched by plutonium production or any other kind of development for a half century.

"You know, I would move out here in a minute and build a house," Erickson said, leaning forward from the backseat and direct-

ing my attention to the encircling emptiness. "Of all this area, darn little is contaminated. It is a beautiful place. But I would be careful about where I sank a well."

To address that point, our Westinghouse guide pulled off the asphalt highway that runs through the Hanford site. Brauer, who used to make videos for Westinghouse Hanford before he semi-retired to teach media courses at the community college, wanted to show off an experimental way of neutralizing some of the toxic chemicals and radioactive waste that Hanford's workers had a habit of dumping in long trenches and burying. Throughout most of the cold war, only the most dangerous of Hanford's waste—concentrated plutonium syrup and other very toxic nucleotides—was stored in underground tanks. There are 177 of these tanks, more than a third of which are known to leak. The vast bulk of the waste was poured or pumped directly into the soil. This included ninety-three thousand tons of volatile organics and other chemicals, half a million pounds of uranium, and four hundred pounds of plutonium. At least 1.2 million cubic yards of soil at Hanford is radioactive, according to the Department of Energy, enough dirt to cover a football field to a depth of seven hundred feet.

"It's called in-situ vitrification," Brauer said proudly, as we got out of the car to see the antidote to hot dirt. It works, Brauer explained, when electrodes are jabbed deep into the ground and enough electricity is pumped through them to power a fifty-story hotel. Intense heat (2,000 degrees centigrade) cooks the soil into disks of black, obsidian-like glass, destroying some dangerous chemicals and immobilizing radioactive waste so it will not leach into groundwater. Brauer said tests have been promising.

What he did not say was that cleanup experts are having a devil of a time figuring out where to jab the electrodes. A lot of contaminated soil at Hanford has been "lost." Technicians kept careful records of how much plutonium they produced, but not of where they stashed its toxic by-products. Not long after my tour, Thomas Grumbly, the Department of Energy's assistant secretary for environmental restoration and waste management, complained that at Hanford "it's as though you had a party every night for forty-five years, and you never cleaned it up." Retired workers have been interviewed to see if they happen to remember what they may have bur-

ied and where. One landfill, discovered to contain barrels of toxic solvent, was dated to the mid-1960s, primarily because bulldozers unearthed aluminum trays from Swanson's TV dinners.

As we drove north along the river toward the reactors and chemical plants that are the toxic heart of Hanford, Brauer and Erickson explained that outside criticism of this place had gotten out of hand. They said the original designers of Hanford had the good sense to locate its giant chemical plants, which produced massive volumes of liquid waste while extracting plutonium from irradiated uranium fuel, several miles from the Columbia. They noted that the chemical plants sit atop 250 feet of sandy soil, gravel, and rock, which they said provides a natural barrier between dangerous waste liquid and the groundwater.

"It turns out that the soil loves this [radioactive] stuff. It just grabs it," Erickson told me, explaining that many of the most dangerous radionuclides that were dumped into the soil, such as plutonium, have bonded chemically with the soil and cannot move into groundwater aquifers that flow into the Columbia River.

What Erickson told me was true, to a point, but too rosy. The original builders at Hanford had guessed it would take up to 180 years for contaminated groundwater to reach the river. But just eleven years after plutonium production began, radioactive groundwater was detected near the Columbia. One underground plume of radioactive tritium penetrated the soil beneath the chemical plants and traveled nine miles to the river in just seven years.

So far, though, the threat of these plumes to people or the environment is minimal, according to a hydrogeologist who does not collect his paycheck at Hanford. Ralph Patt, who works for the Oregon Water Resource Department as that state's expert on figuring out what Hanford might be doing to the Columbia, told me that "there is nothing at the moment in the river downstream from Hanford that even comes close to being above drinking water standards."

Patt said that the Columbia, by pushing one hundred thousand cubic feet of water per second past Hanford, easily dilutes and defangs Hanford's groundwater.

"The good news is the enormous flow of the Columbia, but the bad news is that there is more contamination on its way. The open question is: How long will it take for it to reach the river?

There is a lot of cesium and strontium in the ground at Hanford. It sits in soil about one hundred feet above the groundwater. It will decay away in three hundred years. Will it move down into the groundwater before then? Nobody knows for sure.

"But it is not just radioactive materials that worry Oregon. Just about every chemical known to man has been used at Hanford. This stuff will not decay away. Will some of it get to the river? The answer is absolutely yes. But we can't say how much and how soon."

As we drove farther north toward the reactors, Brauer and Erickson agreed that it would be a good idea for me to see the old Hanford townsite. Its original inhabitants, farmers and fruit growers, had all been ordered out in 1942, when the Army Corps of Engineers swarmed in to erect barracks to house fifty-one thousand workers for the Manhattan Project. Hanford sprouted in less than six months into the fourth-largest city in Washington State. Everything about the place was supposed to be a secret. Rules prohibited the publication of statistics about how much ice cream was consumed on the site. Workers arrived from around the country with no idea of what they were in for. They had read DuPont recruiting pamphlets that said "you'll find a lot of conveniences you wouldn't expect in a construction camp." As promised, there was no wartime meat rationing. The government, desperate to overcome a severe wartime labor shortage, used meat as a recruiting lure. What most workers remember finding at Hanford was Sahara-style sandstorms. They darkened the sky for days at a time. Construction excavation had torn up thousands of acres of sagebrush, allowing the sandy dirt to blow. It turned workers' faces and underwear black. The meat served at Hanford's eight mess halls, which could seat more than five thousand workers at a sitting, was often seasoned with gritty dirt.

"We'd been taught in school that Washington was the Evergreen State," said Larry Forby, of Topeka, Kansas, who was persuaded to come to Hanford by a recruiter from DuPont. "If I could have caught that joker three days after I got here, I would have killed him."

Hanford was a rough place to live. Recruiting pamphlets advised that the most essential thing to bring to the site was a padlock. Men were segregated from women. Whites were segregated from blacks. "There was nothing to do after work except fight, with

the result that occasionally bodies were found in garbage cans the next morning," wrote Leona Marshall Libby, a Hanford physicist. DuPont designed taverns with hinged windows that could be opened from the outside, allowing security guards to toss in brawl-ending canisters of tear gas. Nearly a quarter of the nonprofessional workforce quit within a month. The list of quitters usually doubled during dust storms, which came to be known as "termination winds."

Sagebrush had grown back when I toured what was left of the wartime boom town. The workers' barracks had all been demolished. But the old Hanford High School building, a concrete structure built in 1916, still stood. It was a telling artifact of the action-movie subculture that blossomed inside Hanford during its decades of isolation. The school's roof had been blown off, Brauer explained, for the sheer hell of it. A munitions expert from Battelle Laboratories, one of the lead contractors at Hanford, "blew the roof off without hurting the walls. It was a nice job. The roof went up about six hundred feet," said Brauer, who watched the explosion. Besides its blown-away roof, the walls of the old high school were notable for a wide-ranging exhibition of machine-gun pockmarks. It reminded me of Serbian handiwork in Bosnia. Brauer explained that the Hanford Patrol, an exceptionally well-armed security force that until 1993 was subject to no local governmental control, "used to play a lot of cops and robbers out here."

We repaired to the riverside where a few apricot trees remained from pre-war fruit orchards. The apricots happened to be ripe, but—remembering the mulberry syndrome—I was afraid to eat them. (A couple of weeks later, on another tour of Hanford, I threw caution to the winds and ate two apricots. They were misshapen, but pleasantly tart.) Besides apricots we saw white-tailed deer, a blue heron, a couple of coyotes, and one of the hundreds of towers that are part of Hanford's emergency evacuation system. The towers sample windborne radiation. In case of a major accident at Hanford—the most likely cause of which would be an explosion in an underground waste tank—the towers would assess the direction and intensity of the radiation release and give clues about how to get the hell away from Hanford. Erickson told me that he takes the possibility of a waste-tank accident quite seriously.

"If one of them blew up, I would move out of town for a while,

depending, of course, on which way the wind was blowing at the time of the explosion."

"Look out for rattlesnakes," Erickson warned me, quickly changing subjects as we wandered around the riverbank. He remembered rattlesnakes from the regular noontime jogs he and a pack of N Reactor engineers used to take along the river. "Some of those fellahs would take a dip in the Columbia. They weren't supposed to, because we were downstream from the reactors, but they did and it never caused them any problems. I personally was never too keen about swimming in the river. I still don't. Being of a conservative nature, I would advise against it."

Back in the car, we drove north along the Columbia toward N Reactor, following a narrow dirt tract along which early Hanford scientists had conducted radiation experiments with assorted animals and plants. Brauer explained that "they did serious studies. For example, they put plutonium in the soil to see if flowers would grow. They kept the birds away from the flowers with screens, so they would not fly off the site and shit plutonium."

Back away from the river, in the eastern distance, we could see the hulking buildings and smokestacks of Hanford's "200 Area," where plutonium was chemically separated from uranium. The most imposing of the structures is the clean-sounding PUREX (an acronym for "plutonium uranium extraction") plant, the world's largest plutonium reprocessing facility. It was anything but clean. For every kilogram of plutonium product, it generated 2.5 million gallons of wastewater for evaporation ponds, 55,000 gallons of low- to mid-level radioactive waste for dumping in dirt trenches, and 340 gallons of high-level waste for pumping into underground steel tanks. The plant was closed in 1989 because of steam leaks and has not reopened.

"There's where all the fuel was processed for all those years," said Erickson, pointing east. "I've driven through this area twice a day for thirty years. You know those iodine-131 releases that the downwinders are worried about? [He was referring to massive releases of radiation from unfiltered smokestacks at Hanford in the 1940s and 1950s. These releases amounted to the nation's largest and potentially most dangerous pattern of leaks from a nuclear plant.] Well, I think that very little of that reached the population. None of the workers out here got any thyroid cancers."

This casual statement, more than anything that Erickson told me, was hard to swallow. The secretary of energy formally acknowledged in 1990 that Hanford's releases of iodine-131 (a short-lived radioactive element that collects in the human thyroid, where it can cause thyroid malfunction, benign tumors, and cancer) were high enough to cause illness among people living downwind. Seven years of federal research on the size and spread of the releases have found that about eighty thousand people, including sixteen thousand children, were exposed to more than 10 rads of radiation.* Some children, who drank milk from cows that grazed on irradiated grass, were exposed to a lifetime dose of as much as 870 rads to their thyroid. The head of Hanford's dose reconstruction project has said that some eastern Washington downwinders were exposed to twice as much radiation as civilians who lived downwind of atomic testing in Nevada and who have higher than normal rates of thyroid disease and cancer.

As for workers at Hanford, they have a long history of being misled about the risk of radiation in their workplace. The Atomic Energy Commission knew in 1947 that Hanford workers were exposed to "significant quantities" of radioactive particles. But it chose not to inform them, even as it secretly characterized the exposures as "a very serious health problem." Access to the health records of thirty-five thousand Hanford workers was, until 1990, strictly limited by the federal government to friendly scientists of its own choosing. Since then, a study by British epidemiologist Alice Stewart, an unfriendly scientist who established her reputation by showing a link between prenatal X-rays and cancer deaths in children, has found a correlation between cancer deaths and worker exposure to low levels of radiation at Hanford. Stewart concluded that two hundred workers have lost or will lose years of their lives because of radiation-induced cancer.

Erickson knew about all of this, of course. But he did not believe that it added up to much. Since he struck me as an honest, intelligent, and good-hearted person, I pressed him to explain why

*A rad is a measure of absorbed radiation. It is roughly the equivalent of a dozen chest X-rays. The current federal limit for an annual safe dose of man-made radiation is 0.025 rad. Federal guidelines call for evacuation if the dose to the thyroid reaches 5–25 rads.

he and so many others in the Tri-Cities were convinced that the risk of radiation from Hanford has been exaggerated. The engineer told me, first of all, that he personally has never seen, after three decades of looking very carefully, how workplace exposure to radiation had done him or anybody that he knows any harm.

Second, Erickson, who feels confident designing anything from a home sprinkler system to zirconium cladding for highly enriched uranium rods, said that he and the other smart fellows at Hanford can manage all the plant's safety problems, if only "technical people were not losing out to non-technical people." He complained of meddling on the part of people "who do not understand isotopes." These meddlers included the media, know-it-alls from the West Side of the Cascades, frightened farmers from the East Side of the Columbia, and bureaucrats in Washington.

"You have people who are technically limited reviewing data that they don't understand," Erickson said.

Hanford engineers have never had a problem with self-confidence. They began to swagger in the 1940s, when they "saved" the site's first atomic reactor by intuiting that physicists had screwed up its design. Acting on their own authority, engineers built the B Reactor with extra fuel-loading tubes. Those extra tubes turned out to be the key to fixing a reactor glitch and sustaining a nuclear chain reaction. Seat-of-the-pants guesswork allowed the Manhattan Project to meet its wartime deadline. That, in any case, is the myth among engineers and technicians at Hanford. Whether their job is making plutonium or cleaning up its mess, they are convinced that they can handle it—if only the non-technical types would get out of the road.

"We used to run nine reactors with seven thousand people and we weren't leaking. Now we aren't running any reactors and we have nearly seventeen thousand people. Paranoia is forcing gridlock," Erickson told me.

It all made perfect sense, except, of course, for the facts. When engineers ran nine reactors with seven thousand people, they were indeed leaking into the air and into the river. And their supervisors were lying about it, while refusing to warn civilians about possible dangers.

Erickson tried to convince me that Hanford's technicians were pioneers and their work was a high form of patriotism. Hanford's

myth of the cowboy engineer was a local variant on the riverside myth of the western individualist. Like irrigators with their cheap water and bargers with their bloated river, Hanford's technicians had come to be totally dependent on federal cash and deeply resentful of federal control.

"If they just turned us loose," Erickson said, "we could clean this place up at a quarter of the two billion a year they are spending now. But the way it is now, if you know anything about the nuclear industry, you are disqualified. The public is going to get tired of pouring money down a rat hole."

We drove on to N Reactor, a complex of hulking yellow block-shaped buildings, silvery water tanks, high-voltage transformers, and a labyrinth of steam pipes. Like all the dormant reactors at Hanford, N sits close to the river. That makes the reactors and their simmering waste a cleanup priority.

In the N lunchroom with Erickson and Brauer, the conversation turned to nearby K East Reactor, which had sprung a chronic leak in its concrete fuel basin. The basin was designed as a temporary container for enriched uranium fuel rods. They were supposed to be suspended in water for only a few weeks or months before being transported to the PUREX plant for processing. The closure of PUREX, however, meant that Hanford had no place to process and no place to store the intensely radioactive fuel rods. K East basin held 1,250 tons of them, many of which were broken and corroding. The rods had contaminated the sixteen feet of water in which they were submerged with a vicious stew of plutonium, strontium, cesium, and tritium. In the 1970s, about fifteen million gallons leaked out of the basin and into the soil. Some got to the river, about four hundred yards away. In 1992, the basin leaked again, ninety-four thousand gallons, and Hanford officials announced that they would be giving the basin their "utmost attention." Hanford cleanup officials say that, so far, the consequences of the leaks are not serious. The volume of water in the river, they say, dilutes radiation leaks into insignificance.

"Hey, Lil," Erickson yelled across the lunchroom, speaking to a woman familiar with K East's problems, "you know that basin leak we have over at K? Has that sort of gone away?"

"The leak is running at twenty-four gallons a day," the woman replied. "That is unofficial."

Both Erickson and Brauer blame the K basin leak on outside

meddling in Hanford's business. Had the PUREX plant been allowed to operate, there would be no hot water to leak.

"What they should have done is process all the fuel and then shut down PUREX," Brauer maintained. "The *Seattle Times* will make hay out of this until hell freezes over."

Erickson nodded sympathetically. "It's a very difficult environment to work in," he said.

While we were eating our lunch, about 150,000 fall chinook fingerlings were swimming healthily in another concrete basin at K East Reactor. That storage basin had been an intake facility. It had always contained river water that was on its way into the reactor. The basin had been filled with fish as part of an experiment to beef up fish runs in the Hanford Reach and dispel Hanford's public image as a factory of death. And it worked. The young salmon prospered in the basin before being hauled off to a hatchery and released to migrate downriver.

After lunch, Erickson showed me around the out-of-service N Reactor. We entered the central reactor building through a security gate surrounded by razor wire. After passing through a bewildering maze of instrument panels, we arrived in a large room in which we could see the reactor's towering face. Uranium fuel rods were (until 1987) inserted into a huge wall of graphite.

"It was a wonderful reactor," Erickson said wistfully. "We set all kinds of records for steam production. But it is all gone now."

We drove back away from the river toward the dirtiest part of Hanford, the 200 Area, with its chemical plants and waste tanks. To get there we had to skirt Gable Mountain, a basalt butte. Deep tunnels were dug into the mountain in the 1980s when Hanford boosters were lobbying Congress to choose the site as America's main burial ground for high-level radioactive waste. The plan was to put the waste—once it was encapsulated in glass logs—into tunnels in Gable Mountain.

"We lost that deal because the West Side of the state was against us," Brauer complained. "Those who understood the technology were disappointed."

Erickson joined Brauer in a sigh of regret.

Digging the tunnels, Brauer noted parenthetically, violated a U.S. Army promise not to disturb the mountain. The promise was

made to the Wanapums, a small band of river Indians who were ordered off the Hanford site in 1942. They consider Gable Mountain to be a particularly sacred place and, as I later discovered, are furious with the government for desecrating it.

Beyond the mountain, we caught sight of the plutonium finishing plant, where Erickson's youngest son, Tim, works as a maintenance supervisor. There are few buildings in North America where maintenance is such a critical issue. Deep inside the plutonium plant, which Hanfordites call the PFP, plutonium scraps grow more radioactive with each passing day, as plutonium-241 decays into an element called americium. The scraps present an inexorably increasing health risk to the plant's 650 workers.

Brauer said that we could not drive up to the plant for a closer look. As befits its status as a factory that made "buttons" for nuclear warheads, the PFP was set back from the main highway and encircled by a double row of razor wire. There are television cameras on the fence. Inside, guards in black shirts patrol with machine guns.

About two months later, with a handful of reporters from around the Pacific Northwest, I toured PFP. Each of us had to wear five separate badges. We were not allowed to photograph the black-shirted guards because, as a Westinghouse public-relations person explained it, "they are equipped with certain things we don't want the not-so-nice part of the public to know about." The tour was part of a charm offensive by Hanford to show that the plutonium plant had a problem that could best be solved by starting up the plant and processing volatile scraps into more stable powder.

To get to the heart of the factory, we first had to put on yellow radiation shirts, pants, booties, and hats. Then we filed through two airlocks. Finally, we were allowed a few minutes to gaze through thick windows into greasy chambers where plutonium junk—rags, jars, discarded crescent wrenches—was invisibly festering. "The stuff is off-gassing. We have no other place to put it. All the nooks and crannies are full," we were told.

Inside the plant, I spotted Tim Erickson and waved hello. He nodded nervously and avoided eye contact. Journalists had never before been allowed in the building.

I managed to talk to Tim Erickson one evening at his house, which is an "E," just like the one his parents live in. Tim, a thirty-two-year-old mechanical engineer who earns fifty-eight thousand dollars a year, told me that he always wanted to become an engineer at Hanford. He started at the plutonium finishing plant during the Reagan arms buildup and stayed on for the cleanup.

"I pretty much cut my teeth and grew up at PFP. When you grow up in Richland, you fall back to your roots. My dad is an engineer. All my friends' dads are engineers. As a kid, our teacher told us to write letters to President Nixon, begging him not to shut down N Reactor.

"Richland is proud of itself. I think you could say it is egotistical about itself. In school, we thought, 'We are the Bombers. We are the scientific elite.' People used to say, 'Oh, you're from Richland. You must be stuck-up.' And we were kind of insensitive. We gave plaques to Japanese foreign exchange students that had, you know, the mushroom cloud on them."

Tim expects never to have to leave Hanford.

"There is enough work in the cleanup for a career. The idea of moving does not make me happy."

Outside the gates of the plutonium finishing plant lies Hanford's most intractable cleanup mess—the "tank farm." Because of its potential for explosion and groundwater pollution, it is the primary focus of the government cleanup. On the day I drove around Hanford with Jerry Erickson, access to the tanks was even more restricted than usual. Technicians were installing a giant circulation pump in Tank 101-SY, which habitually burped hydrogen and was considered the single most explosive item at Hanford.

"All the tanks make hydrogen as they decay," Brauer explained matter-of-factly, as if talking about cows passing wind in a barn. "But on the surface of some of the biggest tanks the liquid has developed a crust that is kind of like peanut brittle. This keeps the tanks, particularly 101-SY, from venting the hydrogen slowly and safely. Every eleven weeks or so it farts and that could be a problem."

Hanford had one known and three potential farters. Since hydrogen is highly flammable, sudden puffs of it have the potential

of setting off a catastrophic explosion that could spray radioactive sludge high into the atmosphere.

It took technicians nearly a week to finish installing the pump. When it was turned on, it stirred up the peanut brittle in 101-SY so that it stopped abruptly passing hydrogen. Good news at the tank farm, however, did not hold. Two glaring safety violations a month later forced Hanford officials to order more than three hundred tank-farm workers into remedial safety classes. In one goof, a worker accidentally turned on the new mixer pump inside 101-SY. In the second, a worker tried to unplug a pipe inside a waste tank by tying a rock to a string and lowering it down. He pulled the wet rock up, held it in his hands, and contaminated himself with radiation. At the Department of Energy in Washington, an assistant secretary for waste management characterized the rock incident as "one of the more stupid activities I've heard about on a [nuclear] reservation."

My day at Hanford ended at a respectful distance from the tank farm. Brauer wanted to get home for dinner. I did not particularly want to catch a closer look at high-level waste. As we drove back to Richland in the late afternoon, Erickson leaned forward from the backseat and explained what it is like for an engineer to watch Hanford die.

"My most productive years are sitting out there in a factory that is being shut down. Do I regret it? No, not really. It was really challenging working there. It was fun. I took care of my family and sent my boys through college. If a man can do that, he has done enough. The rest is just ego. It was a good place to live and die and whatever."

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