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# It's a gas!

## Searching Montana's radon mines for the difference between your health and a hole in the ground

by Andy Smetanka

Boulder, Mont. in many ways is the typical Montana small town. No traffic lights. Rush hour means getting stuck behind four other cars waiting for a worker in an orange vest to wave you through a dusty patch of roadwork. Instinctive friendliness is tempered with a prophylactic layer of caution; locals look you over for an uncomfortably long two seconds when you walk into a bar. As did the grocer who pointed you there, squinting warily behind a reflexive smile when you asked if the place across the way was the same one where Dallas actor Patrick Duffy's parents were killed in a hold-up back in the '80s.

But Boulder also has something that most small towns in Montana don't. You can't miss the signs, most of them tidy and new, but at least one still pulsing a feeble chartreuse after fifty years on the side of a downtown building. Two modest ad campaigns for the same service compete for attention right up Depot Hill Road on the edge of town, when one drops out of the competition at the turnoff to Lone Tree. The last mile or so belongs to Free Enterprise, a sky-blue cinderblock building perched on a hillside with a commanding view of the town and the Boulder Valley.

Free Enterprise and Lone Tree are "health mines," holes in the ground where radioactive gas leaches out of the surrounding rock and soil and people come from miles around—sometimes hundreds or thousands of miles around—just to breathe it in. Many who do so claim almost miraculous relief from a whole host of ailments ranging from lupus and multiple sclerosis to carpal tunnel syndrome and tennis elbow. "In 1996 I couldn't even dress myself or get out of the bathtub without help," reports one of 15 guest testimonials in the full-color Free Enterprise brochure, "But now I've been deer hunting, danced a couple times and

played my guitar. I can even type a little." Other testimonials list similar successes great and small—though all undoubtedly great for their authors—from being able to play tennis again to regaining the ability to walk. Visitors sound grateful and relieved, often surprised by the results. Some confess outright that inhaling radioactive gas was a last-ditch attempt to feel better after batteries of narcotic pain relievers failed to produce.

"People will try anything," Free Enterprise owner Pat Lewis says, "and when you have your health, it's hard to relate to those who don't."

She's right. The active agent in a health mine is radon, a colorless, odorless, and tasteless gas released by the decay of uranium. The Environmental Protection Agency lists radon as second only to cigarette smoking as a leading cause of lung cancer. You don't need to go to a health mine to breathe it in, either: The agency estimates that anywhere from 14,000 to 40,000 Americans will die this year from radon-related cancers caused by the gas seeping into their homes (and schools, and offices) from the surrounding soil and collecting in dangerous concentrations. People who have their health might find it hard indeed to believe that those who don't would try to retrieve it by deliberately inhaling a substance that the EPA claims is one of the last things you want to go around breathing if you don't have to.

### Ask doctor science

Anytime someone tells you something is colorless, odorless and tasteless, the first thing you try to do is see it, smell it and taste it—or at least go through the motions, mentally, of seeing without seeing, smelling without smelling, and tasting without tasting. Radon, like many chemical elements and invisible gases in particular, defies each of the five major test-kits we're equipped with to process stimuli from the world around us. Miracle worker or silent killer, on some level it's an affront to our senses that we wouldn't know radon from Adam if some scientist hadn't announced it was everywhere. There are a lot of things like that.

For 19th century scientists working to fill in the gaps and corners of the periodic table, radon proved to be a fairly elusive quarry even for an invisible gas. It was the sixth and last to be discovered of the noble gases, a chemical group so dubbed by scientists for the apparent standoffishness of its members, none of which are naturally inclined to form compounds with other elements. For their perceivedly snooty behavior, which actually stems from a "saturated" configuration of electrons in their outer atomic shells, the noble gases were once thought to be exceedingly rare, and for that reason were once called rare gases.

We now know that argon, whose name comes from the Greek word for "inactive," is the third most abundant gas in the Earth's atmosphere, and neon ("the new") the fourth. Scientists in the 1960s also discovered that certain noble gases could, in fact, be persuaded to form compounds, though generally only under great duress. The "noble" designation caught hold and stuck, as author P.W. Atkins puts it in The Periodic Kingdom, to imply "a kind of chemical aloofness rather than a rigid chastity."

In addition to being the last noble gas to be discovered, radon is heaviest of the six and the only radioactive one. It also tops the list for a number of other properties, including highest boiling point, melting point, critical temperature and critical pressure. For a substance that presents so little of its character to our five senses, radon is certainly a character among the noble gases. Though not as abundant as neon or argon (let alone nitrogen or oxygen), radon is not especially rare, either. It has been estimated that every square mile of soil to a depth of six inches contains about one gram of radium, one of radon's forebears in the uranium decay chain, constantly releasing the gas in tiny amounts into the atmosphere.

Any place with uranium—like a uranium mine—is going to have a higher concentration of radon. As uranium decays, it ejects certain atomic particles and transforms itself into a number of different elements before finally settling down, several billion years later, as a non-radioactive isotope of lead. In the interval, it will have experimented with over a dozen atomic personalities in phases lasting from a few millionths of a second to 245,000 years. Some will exist as the isotope Radon 222 for 3.82 days, the time it takes for half of its atoms to decay into something else—and plenty of time to keep an old mine shaft filled with a colorless, odorless and tasteless radioactive cloud.

### Better living through radon

Pat Lewis's late grandfather, Wade V. Lewis, founded the Free Enterprise Radon Health Mine in 1952 and ran it until his death in 1974. In 1949, Wade, Sr. was one of three men to discover the presence of radioactivity, using a Geiger counter, in an abandoned silver and lead mine on the hill outside Boulder now occupied by the health mine. The popping and clicking turned out to be uranium—as desirable a commodity as silver in 1949, with federal premiums paid by the Atomic Energy Commission making uranium deposits the subject of intense and occasionally lucrative prospecting around the state and the rest of the country. After acquiring a lease and subsequently purchasing the property, Lewis and his newly-founded Elkhorn Mining Company began mining uranium

ore and selling it to a processing company in Salt Lake City, where it was most likely acquired by the Atomic Energy Commission for industrial and defense uses.

But Wade, Sr. discovered something else in his mine, too. According to his self-published book, Arthritis and Radioactivity, two years after uranium was first discovered in the Free Enterprise, a woman visiting from Los Angeles asked to be lowered into the mine so she could see its inner workings. When she mentioned, en route to a drift at the 85-foot level, that she suffered from bursitis, Lewis facetiously told his guest that perhaps the underground radiation might help. Twenty-four hours later, Lewis writes, the woman's husband called from Helena to say that his wife was "miraculously" free from the pain which had previously prevented her from lifting so much as a kitchen utensil. The woman recommended the treatment to a fellow bursitis sufferer, and three weeks after a series of visits to the Free Enterprise, this second visitor also wrote Lewis to report positive health effects.

"Thereafter," writes Wade, Sr., "the stampede started." Over the next few years, thousands of arthritis suffers flocked to the Free Enterprise and other mines in the area looking for relief, with the result that by early 1952 almost a dozen health mines sprang up between Boulder and the neighboring town of Basin. In July of that year, Life magazine ran a huge spread about health mines. Fifty years later, about half that number are left. The Free Enterprise, explains Pat Lewis, is where it all began.

A handsome, stocky woman who today runs the mine with her brother and her husband, Lewis gives me a quick tour of the Free Enterprise. It's not fully open yet for the season and won't be until later in April, when the 400-feet-underground therapy gallery becomes accessible by an elevator that goes down 85 feet to the old mine shaft, or "drift." When that happens, guests will be advised to wear warm, comfortable clothing and bring along cards, reading material, and blankets and pillows for quick naps while they breathe in the gas. To judge from a postcard on sale in the lobby, impromptu banjo recitals are also a popular way to pass the time. The treatment costs $5 per hour-long session, with first-time visitors encouraged to commit to a program of 32 hours spread out over about ten days. Thirty-two hours also happens to be the limit of annual radon exposure suggested by state health officials, who otherwise take a hands-off approach to dealing with the health mines. The ten-day program, which costs $150, is recommended to determine whether or not the visitor will experience positive effects from the treatment. First-time visitors to health mines are also cautioned that they might experience "flu-like" symptoms after their initial

exposure, but that the symptoms should pass quickly and, in any event, signal a positive response by the body to the treatment.

For guests uncomfortable with elevators and mine shafts, or who need to be in a warmer environment or closer to the restrooms, the Free Enterprise also has an above-ground Radon Room. The gas is pumped up from a second drift at the 105-foot level, filtered to remove dust particles, circulated and eventually returned below ground. With its rusty-brown carpet, bare walls and general rumpus-room feel, the Radon Room could practically pose for a radon campaign designed to draw attention to simi- larly besieged dens and rec rooms in basements across America. Except, of course, that this rec room is supposed to be full of radon.

Lewis is used to writers and news people sniffing around the mine, intrigued by the therapeutic applications of radioactive gas as well as the high roadside-attraction factor of the place. She spends much of her time tracking down information about radon and related topics over the Internet, sifting through reams and reams of studies and articles to find the ones she thinks look legitimate. When she finds one, she prints it up, files a copy away in an enormous three-ring binder in the lobby and makes extra copies to hand out to people—mostly patients—who might have questions about the therapy.

"It's incredible, the information out there when you start digging," says Lewis. "But it's not one-size-fits-all. A lot of people come in and say 'I don't care what it is, I want it to work on me. How do I do it?' But that's not the way of the world these days. If they want information, we try to get it for them. I'm not going to drag somebody across the country to come here if I don't think it's the right thing for them to do."

### The dose makes the poison

The problem with doing research and studying "studies," especially over the Internet, is that so much of what you're getting comes from secondary sources, sprinkled with figures from who knows where and not infrequently tailored to suit the interests of whichever individual or organization is maintaining the Web site. "Studies show" is a recurring mantra meant to claim a measure of authority in this roiling sea of often conflicting information—the Internet equivalent, in most cases, of talking to someone who constantly buttresses his opinions with "They say." Who says?

Radon-related sites, both pro- and anti-, can be perplexingly contradictory. One side of the argument holds up this set of statistics as proof that radon—and radioactivity generally—is bad for you in any concentration. The other side digs through that same set of facts and figures to demonstrate that at certain doses it

can actually be good for you. In this respect, the whole radon debate is a little like the uranium decay chain: Facts and figures always seem to be morphing into something else.

Compounding the problem of scientific veracity is the fact that the particulars of radioactivity are extremely difficult to discuss in simple terms, in no small part because there are so many different units of measurement involved in discussing gas concentrations and exposure levels: rads, rems, becquerels, milliRoentgens, picoCuries, milliSieverts and so on. The measurements aren't readily convertible in such a way that an ailing man or woman can walk right into the Free Enterprise Radon Health Mine and get straight answers to simple questions like "How much radiation will I be exposed to?" or "How much radon should I breathe?"

"You see how hard it is to relay this information in layman's terms?" Pat Lewis is leafing through a sheaf of photocopies looking for the page that she thinks comes closest to putting health mines into perspective compared to other sources of radiation. The Free Enterprise brochure actually includes a handy chart for gauging annual exposure to radiation. According to this study, 40 hours of treatment in the health mine (at 6 milliSieverts) is about what you'd get anyway (6 to 12 milliSieverts) just living in the Rocky Mountains for a year.

Even the Montana Department of Environmental Quality makes an exception for the radon found in health mines, which it describes as "benign and beneficial" even though the active ingredient is the same radon that poses a health risk in the home. Radon therapy, Lewis says, is all about levels of exposure. It's rooted in the principles of hormesis, akin to homeopathy and predicated on the philosophy of Paracelsus: All substances are poisons, there is none which is not a poison. The right dose differentiates a poison from a remedy.

"It's based on the concept of the dose making the poison," Lewis asserts, "and it applies to all agents. There's a point where every agent is detrimental to health. There are people who say that radiation at any level is not good, but mankind and the whole world developed in a radioactive background. It is part of us, we are part of it. It has to be there."

Naturally, the studies that Lewis prefers to share with her guests are generally the ones that point toward health benefits from low-dose radiation while also supporting her assertion that EPA studies about the scary potential of domestic radon are, as she puts it, "junk science." To date, she says, the sum total of data that the agency can marshal against radon is drawn from dubious group studies conducted on underground miners and later colluded into one big study. The projected cancer rates given by the EPA, she says, are simply statistical

likelihoods extrapolated from studies of miners who were exposed to lots of nasty substances besides radon: diesel fumes, silicate dust, coal dust from the mines—and never mind, Lewis asserts, that many if not most of the miners were heavy smokers.

"Hypothetical," she declares flatly. "Purely hypothetical. First of all, the people who are against radon..."

She trails off and pauses to regroup her thoughts. "Radiation is all dose and application," she resumes. "Levels. Degrees. The people who are anti-radon are probably that way because that's the way they've been educated. They're looking at the bad things. They're looking for the dead mice. They forgot to look at the happy mice, the healthy mice, and the things that are benign or beneficial are not an issue. Nobody's gone there.

"Everybody thinks their research is the good research and nobody else's is," Lewis says sourly. "What do you do?"

"It's a big topic," she sighs, "And it's hard to do it justice. But there's a method to the madness, and we're trying to make sense of it—to people who have no other choices."

**How much radiation do you want?**

Doug Kikkert is one of Lewis's anti-radon people. It's his job. As Environmental Health Specialist for the Missoula County Health Department, he would consider broadening public awareness of anything ranked by the EPA as the second-leading cause of lung cancer to be of paramount importance. The radon awareness advertisements that regularly appear in the Independent are there because Kikkert filed for a $7000 grant from the EPA through the agency's regional office in Denver to pay for them. For $5, you can purchase a test kit from Kikkert's office: a packet of charcoal to be exposed for four to seven days and then mailed off to a lab that measures your domestic levels by weight and sends you the results.

The radon found in health mines comes from nearly vertical veins of uranium minerals that traverse the granite of the Boulder batholith. Domestic radon, on the other hand, seeps into houses from the surrounding soil and concentrates in low-lying areas like basements and crawl spaces. Concentrations tend to be higher in the winter, when Kikkert's awareness campaign focuses on detection and mitigation, because of a "chimney effect" caused by the warmth of the house.

"The ground is frozen," Kikkert explains. "The only thawed place in the yard is the footprint of the building, and the gases are concentrated there. Cool, moist soil gases take the place of the hot air escaping through the roof and windows and chimney and the cracks in the house."

"Radon is concentrated more in the lower levels," he continues, "and then it's basically just diluted as it goes upstairs because of the air movement from windows and so on. It's very consistent that basement levels are twice what they are on the first floor, and they halve with every floor you go up. And it doesn't settle. Radon gas is a little heavier than the rest of your air components, but there's a Brownian effect that bounces the molecules around and evenly distributes them in a space like a basement."

Fortunately, retrofitting your house to reduce radon levels can be a relatively inexpensive procedure—compared to getting cancer, anyway. The most effective mitigation, according to Kikkert, consists of drilling a four-inch hole in the concrete footing, scooping out a pocket in the dirt, inserting PVC pipe fitted with a small inline fan through the concrete and directing the pipe out of the house through a roof or wall. Preferably through the roof, where the gas will dissipate and not get sucked right back into the house because of the chimney effect. It costs about $300 in parts, Kikkert says, and contractors charge about $1500 for the drilling and fittings.

"Expense-wise, it's not like having a sinking foundation or asbestos or lead water lines that need to be replaced. But still, yeah, it takes an effort and an incentive to do it. Another advantage is that you get a drier basement. Pull the moisture—and other soil gases—from beneath the slab, and that reduces your heat loss through the concrete. And you get rid of the radon."

Interestingly, Kikkert readily concedes the very point that radon advocates argue so persistently: Researchers have yet to find a conclusive link between radon and lung cancer. But then again, he adds, officially the jury is still out on a number of environmental toxins often regarded as carcinogenic, including DDT, saccharin and the pesticide Alar. Risk assessments and projected fatalities for radon and other substances are calculated by National Science Foundation committees based on data gathered from laboratory and environmental tests, neither of which produces one-size-fits-all conclusions. In laboratory tests, animal subjects are bombarded with doses of radon many times higher than domestic concentrations. If this produces harmful effects in the subjects, the human risk is calculated, essentially, by converting mice to people.

Environmental studies like the ones conducted on underground miners, Kikkert explains, might seem even less convincing to skeptics because there are so many variables to take into consideration: length of workday, type of mine, presence of other pollutants, and so forth. In this case, too, risk assessments are extrapolated after valiant attempts to standardize data and factor in variables as the studies are compiled.

I ask Kikkert whether the EPA's baleful estimates of domestic radon deaths might not themselves be an artifact of the mutagenic calculating process. As the pro-radon people say: "No dead bodies!"

"Sure," he shrugs, "could be. But I'm not a statistician. And what do they say? There's liars, there's damned liars and then there's statisticians. And that's what a lot of people in the scientific community are saying—that these aren't appropriate statistics, throwing all these different conditions together. That's the hazard of environmental studies—you have those variables. But subtracting all of those as best the National Science Foundation community could, there's still a climb in lung cancers that matches radon levels. That's the kind of impending proof, or as good as it's going to get, that there's a link. It's radiation, and I ask people: 'How much radiation do you want?'"

**Flu-like symptoms**

Back on the road, the Montana radon tour concludes with a visit to the Merry Widow Health Mine, just down Highway 15 from Boulder outside the old mining town of Basin. You can't miss this place, either, unless for some reason you fail to notice the banner with four-foot-high letters strung across a gully on the hillside overlooking the highway. The road to the mine wends through a wooded picnic area with RV hookups, across a steel-sided single-lane bridge and up the side of the hill to a pea-soup-green office building next to the mine entrance.

The Merry Widow, which also started as a precious metal mine in the 1860s, is a "wet" radon mine, as opposed to the "dry" operation at the Free Enterprise. Radon is moderately soluble in cold water and guests at the Merry Widow take the cure by drinking it and soaking afflicted parts in it. The air in the mine is damp, making it feel considerably colder than its year-round 60 degrees. White patches of saltpeter blossom from the rock overhead, and parts of the drift are so coated with moss that the water collecting on the thin green filaments makes the cave wall in places look like one big sundew plant. Bare spots are covered with thousands of inscriptions from past visitors, in English as well as Cyrillic and Korean characters. Corkscrew incandescent bulbs light the way every five paces or so. It smells like the musty wooden interior of a health-club sauna.

The drift runs back about 400 feet, at which point it's blocked off by a charming trompe l'oeil stand-in for the last 150 feet of the mine painted on an irregular piece of plywood. The year's first visitors have begun to arrive, and here they sit: half a dozen of them, resting under the heat lamp at the deep end of the drift and chatting among themselves. A five-year-old moppet lies sprawled across her mother's lap. She's got polyarticular rheumatoid arthritis, her mother tells me, and they heard about the Merry Widow by word of mouth all the way down in Georgia. Halfway into the ten-day cure, she seems to be doing much better: "She's running around again." A middle-aged Canadian couple tell me they're skeptical, but they won't make up their minds until they see how it works on the woman's arthritis. Mostly they sound skeptical about finding new things to do around down-at-the-heels Basin during their stay. "We've been sightseeing a few times," the man tells me, "but we've run out of things to see."

A Saskatchewan man who looks like a rancher says he comes here regularly for his asthma. The elderly woman next to me is regularly escorted to the mine by an elderly man whom I met earlier in the office. She used to be a wonderful pianist, he says, before the arthritis. The gas helps restore movement in her "screwed-up fingers."

Oddly enough, his frail companion seems genuinely frightened by the mention of domestic radon, which I tell her will also figure into my story. She insists that I send her information on how to obtain a radon test-kit so that if she's got radon in her house, she can figure out how to get rid of it. It reminds me of the old TV ad with Madge the Manicurist: For crying out loud, lady, you're soaking in it! She gives me her address and I promise to clip the advertisement and send it to her as soon as I get home.

Before I know it, I've been chatting with the guests for over an hour. I've taken a radon treatment without even thinking about it—somewhere in the back of my mind, I'd sort of figured it would be more like sitting in a hot spring. I say my good-byes and find my way out.

I hang around the office for awhile waiting for owner Dwayne Knutzen to come back from town. To pass the time, I check out the souvenir items for sale: coffee cups, ball caps, engraved belt buckles, a radon pillow with a chunk of uranium ore in it for $22.50. When Knutzen returns, we talk a little bit more about the pros and cons of radon. Understandably, Knutzen is pro. He bought the mine from its previous owners three years ago after making his own inquiries into the health benefits of radon.

"It was for sale," he says, "and I was looking for something. I kept thinking, ah, radon is supposed to kill you just because the EPA says so. I started digging into it and everything I found that was a scientific study pointed to better health. Everywhere in the world it points to better health except for here [in the U.S.]."

Knudzen tells me he's expecting a team from National Geographic the week after my visit. Like Pat Lewis, he keeps his office well-stocked with photocopied articles to help answer questions and bust prejudices. I end up leaving with about 20 more of them to add to the pile I got at the Free Enterprise, as no doubt will the writer and photographer from National Geographic.

"I haven't even had a head cold since I bought the mine," Knudzen claims. "I can't get sick. I've been trying to get a day off."

He says he gets plenty of radon just doing maintenance and checking on his guests. Before I leave, we take turns breathing into his Geiger counter. Fifteen minutes after leaving the drift, my breath shows ten times the radioactivity of his.

On the drive home, I feel the "flu-like symptoms" coming on—the aches and pains and general rattiness that the anti-radon people might point up as evidence of low-level radiation poisoning, but that pro-radon advocates would claim as a sign that the radon is beginning to work its magic. Like most people, I guess, I'm suspicious of remedies that start by making you feel worse, especially since I didn't feel bad to begin with.

Halfway through the three-hour drive, I got a second set of chills when NPR's regularly scheduled programming—"Afro-Pop Worldwide"—was interrupted to make room for a special bulletin that war had broken out. One chill or the other lasted the rest of the drive and then some. Couldn't really tell you which.