Devoted to a Fault
By Timothy Lesle

The following was reported in late 2007 and early 2008.

Hayward

Phil Stoffer squinted through the glass to see a sign of the past and, almost certainly, the future of this part of California. He knew what he was looking for and grinned when he found it. It was a crack, a big one. Stoffer held a hand near his wire-rimmed glasses to block the glare and traced the path of the crack as it ran along the high ceiling, then down a sea-green wall. Smaller cracks fractured the wall farther down and along a sweeping flight of stairs to the floor.

We were in Hayward, California, a small city across the bay from San Francisco, south of Oakland, north of San Jose. We stood in a little alcove pressing our noses against the outside of a modest side door. We were looking into what was, once upon a time, Hayward City Hall. It looked the part. It was an imposing concrete structure painted a sandy beige. It had a cornerstone inscribed MCMXXX and was decorated with geometric art deco flourishes and cornices shaped like the heads of cattle and goats. On one side of the building was busy Mission Boulevard, where Stoffer's car was parked, and some landscaped grounds. Near its southern corner was a shiny, new playground where children swung back and forth through the air. There were a few other buildings on the block, but this one was abandoned, full of broken windows and old office equipment. Stoffer pointed out more cracks.

They were evidence of a much larger crack in the ground underneath. That crack is the Hayward Fault. Though the nearby San Andreas Fault is more famous, and much bigger, scientists like Phil Stoffer believe the Hayward poses a more imminent threat to northern California. Stoffer is a geologist with the U.S. Geological Survey who works from an office in Menlo Park, one of the small cities that make up Silicon Valley. Much of Stoffer's current work entails mapping the remoter parts of Arizona's Navajo reservations, where the geology is not overlain by development. But Stoffer had also been assembling a layman's guide called "Where's the Hayward Fault?"

The answer to that question is unsettling: the Hayward Fault is under one town after another along the eastern edge of San Francisco Bay. In his guide, Stoffer describes sites along the fault that are of historical or geological interest. He also highlights locations where locals can reach the fault by bicycle, foot, or mass transit (but not by car—it's subtitled "A Green Guide to the Fault."). The day we visited Hayward, we were going to add a few more sites to his guide.

This project is part of a larger effort this year to highlight the Hayward Fault. A group called the 1868 Hayward Earthquake Alliance is commemorating the 140th anniversary of a big earthquake on the fault. The alliance's chairman is Tom Brocher, a senior USGS seismologist. If 140 is an unusual number for an anniversary, Brocher has his reason: "The Hayward Fault takes about 140 years to accumulate strain for a big earthquake. And that time has pretty well come and gone."

Stoffer set off past the expansive set of concrete steps at the city hall's main entrance and ambled along a cement sidewalk around the corner of the building. He carried a coffee cup and wore blue jeans and a plain gray sweatshirt with the initials USGS printed in small letters on the front.

I followed him around the corner. Several feet in, the sidewalk on that side of the city hall abruptly shifted to the right, putting a kink into the straight ribbon of cement. It looked as if the workers who laid it down realized, after planting a few squares of cement, that they had misread the plans by a couple of inches.

In a parking lot full of cars north of the old city hall, Stoffer pointed to a red brick building with dozens of metal plates screwed into the walls. "Classic retrofit," he said. He continued north and admired several curbs that had been either cracked or warped severely, each one veering to the right and then straightening again, as if correcting course. We stopped in another parking lot and Stoffer paced back and forth along a series of cracks in the asphalt, each about a foot long. The cracks were parallel to each other and scudded along an invisible line through the parking lot, like the wrinkles at the corner of a smile or a string of Christmas lights.

"These are en echelon cracks," Stoffer said. They had formed because the Hayward Fault was directly underneath the parking lot. As the chunks of earth on either side of the fault crept past each other, the moving earth tugged at the asphalt above, cracking it. The fault also created the kink in the sidewalk, and the bent curbs; it's the reason the old city hall was cracked and abandoned.

Stoffer swung his arm roughly northwest to southeast, indicating the trend of the en echelon cracks. They emanated from a small shop next to the lot, On Time Signs. Stoffer opened the door, a little bell rang, and soon a young woman appeared at the counter, asking if she could help us. Stoffer needed information: "Do you make neon signs?"

They did. He asked how much it might cost to make a little green dinosaur. He had been toying with an idea for another project, which he declined to describe. He asked how much neon lettering costs. The woman told him that the price depends on the number of bends it takes to make each letter. He asked her what she thought of working on top of a fault.

A couple of weeks earlier, an earthquake occurred near San Jose, on yet another Bay Area fault, the Calaveras. The Bay Area took notice—it had a magnitude of 5.6 and was felt throughout the region. The next day, the San Francisco Chronicle warned that this quake increased the chances of earthquakes "along the much more dangerous Hayward Fault." Stoffer thought of it as the "perfect" earthquake. Perfect because it did so little damage, yet was big enough to be widely felt and covered by all the local media. It reminded locals that they live among active faults. And it gave Stoffer and his colleagues an opportunity to talk about the threat posed by the Hayward Fault, as well as the need to be prepared.

"It's a concern," the woman behind the counter answered. "But what are you going to do?"

Lake Temescal

Stoffer wanted to visit Lake Temescal to take some photos for his guide. He had some trouble getting there. Most of that trouble came from other cars. It was a long drive from Hayward to this little corner of a long valley tucked into the exclusive hill neighborhoods of Oakland. He drove a red Subaru wagon with a Darwin fish affixed to the back. Stoffer had to swerve mightily to avoid being sideswiped by a truck as he drove onto highway 254, then got caught in a jam on interstate

880, surrounded by rumbling tractor trailers bound for the nearby Port of Oakland. He negotiated the traffic and switched onto the 980. “Look at this tangle of freeways,” he said as he passed under a knot of freeway interchanges that rose two, three, and four stories into the air. Here the 980 met the 580 and became state highway 24. “Would you want to be here during a major earthquake? I assume it’s built to code.”

The exit for Lake Temescal was poorly marked. Stoffer’s first glimpse of it was at 40 miles per hour as he zipped past, consequently merging from highway 24 onto the Warren Freeway. He took the nearest exit and hooked onto a street called Broadway Terrace; it shunted us up a steep hill and into the affluent upper Rockridge section of Oakland. Far below were Lake Temescal and the fault.

Stoffer drove down the other side of the hill, passing huge homes. He followed the road through a golf course and stopped at a crosswalk to let a golf cart cross to the next hole. As he circled back to Lake Temescal, he craned his head over the dash to better examine the pavement ahead of him. “Gosh, those cracks running down here are pretty suspect.”

After a few more turns, Stoffer pulled into the parking lot at Lake Temescal. One side of the lot was hemmed in by a steep hillside—the same hill Stoffer had just crested. At the very top was a house that looked like it was built on the crowns of the trees below it. A little push, it seemed, and the house might tumble into the lot.

Stoffer rummaged in the back seat and pulled out a tripod and a pair of small digital cameras, which he screwed onto a metal bar on the top of the tripod. As part of his field guide, he was also including 3-D photographs of cracks, buildings, or the scenery—thus the twin cameras, which, like a pair of eyes, would produce a stereoscopic view. He walked over a green, manicured knoll to get a better view of the lake.

Temescal is a sag pond , dammed at one end to hold water, that formed in a depression in the ground—a sag—created by the Hayward Fault. During hot summer days, it is a popular swimming spot. On its northeast shore is a small stretch of beach and nearby is a stone house built by the Works Progress Administration. But that November morning, the kids who might otherwise be found there were in school at nearby Chabot Elementary and College Prep. The lake was quiet, its surface interrupted only by a few ducks. A light fog hung overhead, and the leaves on some of the trees had turned. It looked like a Hudson River School painting.

Stoffer took a couple of snapshots and then strode across the grass in search of signs of the fault. He studied several cracks in a paved hiking path, but didn’t think they showed anything. He wandered closer to the highway and sized up several ruptures in the pavement. Tree roots, he decided.

The Hayward Fault runs along the length of this valley. It’s believed to be the reason the valley exists, its motion enabling the forces of erosion to carve the valley out more easily. But Stoffer was searching for signs of creep. He wasn’t having any luck.

The blocks of earth along the three miles of the fault just below the surface tend to move past each other slowly, on the order of a few millimeters per year. That motion, or creep, can often be detected as it damages all the stuff people build above the fault—like downtown Hayward. (Unsatisfied with our initial survey, Stoffer went back to Lake Temescal and found en echelon cracks and an old rail tunnel that had been offset by creep at the lake's southern end.)

"The little effects," Stoffer said, "aren't anything tremendous. But it's an amazing story." Still, those little effects are only the faintest harbingers of the fury buried miles below the surface. The fault extends about eight miles below ground, and the sections of earth along the fault below the three-mile mark—the part that's not creeping—are stuck to each other. Because they aren't moving, they are building up the stress that fuels a big earthquake.

Tom Brocher, the USGS seismologist, visualizes the earth on either side of that deep section of the fault as a pair of metal sheets similar to those seen on roads. They lie flat, and are pressed together along their thin edges. At a few places, those sheets are welded together—in geological terms, those spot welds are called asperities. "And somebody has grabbed these plates and tried to rip them apart," Brocher said in an interview in his office. His hands pantomimed someone struggling to open a stuck drawer. "For a while, those welds will hold. But eventually they break. And that's the earthquake."

A recent USGS map shows many of the fault's active surface traces, a series of bold red lines that underlie homes and offices and roads. But in some places, like Lake Temescal, the line peters out, replaced by a timid little thread showing where the trace of the fault probably is. Stoffer wouldn't be making that red line any bolder the day he visited.

"This would be a good place to come after a major earthquake," he said, as he walked back to his car. "At least you'd have water."

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At 7:53 in the morning on October 21, 1868, a major earthquake struck the Bay Area. It had a magnitude of about 7, scientists believe. It occurred on the Hayward Fault. The shaking lasted for more than 40 seconds and damaged property throughout the Bay Area. Thirty people died. It was known as the "great quake" until the 1906 earthquake supplanted it. Most of the buildings in Hayward suffered severe damage or were destroyed. As one USGS publication notes, "few places have paid so dearly to have an earthquake fault named after them." This is the earthquake that Tom Brocher and his 1868 Hayward Earthquake Alliance want people to know about.

On a bookshelf in Brocher's office at the USGS campus in Menlo Park sits an empty box of novelty earthquake cake ("My wife gave it to me. But I ate it," he admitted). Next to it is a small toy globe with a little string dangling from it. Brocher pulled the string and the planet trembled in his hand. He considered an Arnold Schwarzenegger bobble-head doll on another shelf. "I haven't taken it out of the box," he said, "but it would be a good earthquake detector."

The alliance is a coalition of public and private bodies dedicated to raising awareness of, and promoting preparation for, the threat posed by the Hayward Fault. (Stoffer told me that it was Brocher who asked him to put together the Hayward Fault guide.) The Bay Area has a 63 percent chance of a major earthquake in the next three decades, and the Hayward Fault is the likeliest to

rupture. “We tell people there’s a two-thirds chance,” Brocher said. “Somehow it’s not as compelling as telling the 140-year story.”

Brocher does not look forward to another earthquake. He remembered the 1989 Loma Prieta earthquake, the last major quake to hit the area.

“Generally when you feel an earthquake, you feel it at its maximum and it kind of decays,” he said. “That earthquake, every new wave was bigger than the one before. They just kept getting bigger and bigger and bigger, and I wondered, ‘When is it going to stop getting bigger?’”

But he cautioned against using the Loma Prieta as an indication of what to expect from a Hayward earthquake. For one thing, that quake was too far away. “The Hayward Fault—when it ruptures, it’s going to be in people’s back yards. That’s the reality we need to prepare for. It’s no good preparing for Loma Prieta.”

It’s an 1868-style earthquake that worries Brocher and the alliance. The Bay Area was far less developed in 1868. Hayward was a town of about 500 people; San Francisco had 150,000 residents. More than five million people would feel a Hayward quake today. A trillion-and-a-half dollars worth of property would be at risk.

Those figures come from a company called Risk Management Solutions, headquartered in a corporate office park in Newark, south of Hayward, along the edge of the bay. Its specialty is modeling catastrophes and quantifying their risks for insurance companies—whether earthquakes, hurricanes, terrorism, or plagues. A portrait of Tetsuya Fujita, whose name puts the “F” in the F-scale of tornado strength, hangs in one hallway. In the lobby, display cases hold free reports on China’s 1976 Tangshan earthquake and the threat of a flu pandemic.

RMS predicts losses of about $165 billion worth of property. Of that, $75 billion would be commercial; the remaining $90 billion would be residential property. “They’re staggering numbers,” said Mary Lou Zoback, vice president of earthquake risk applications at the company and a geophysicist. Only a fraction of that is covered by insurance, and, after deductibles and limits to coverage, insurance companies are only on the hook to pay about $4.5 billion to homeowners affected by a quake.

“In insurance terms, we call it a super catastrophe, or super cat,” she said. The effects ripple beyond the immediate losses, as people have difficulty getting to work and utilities—water, power, gas—take time to come back on line, resulting in lost business and wages. “People come from other countries and say, ‘We’re in America, the most advanced country in the world. Surely it’s better prepared than, say, Guatemala.’ Well, it may not be.”

The 1995 earthquake in Kobe, Japan, helps put the potential damage from a Hayward quake in perspective. Kobe is sited along the Osaka Bay, and its Nojima Fault is the same kind and roughly the same length as the Hayward Fault. It is a major population center bound by mountains on one side, water on the other, and heavily populated flat land in between. In Kobe, a phenomenon called liquefaction was a major source of damage. When liquefaction occurs, the ground loses stability because it is saturated with water. As a result, buildings, sidewalks, roads,

and other structures can sink or tip over. Geologists expect similar damage along the margins of San Francisco Bay, as well as strong shaking throughout the flatlands. The Oakland and San Francisco airports, as well as all port facilities, may be severely affected.

Much of the major infrastructure of the region has been, or is in the process of being, retrofitted to improve its ability to withstand earthquake. But homes and businesses are another thing. In 1996, the Earthquake Engineering Research Institute released a report on the possible effects of a Hayward quake. One chapter is entitled "Commercial and Residential Buildings Affected by Ground Motions." It was written by a structural engineer who traveled along the fault, highlighting buildings that he expected would be damaged or destroyed. Twelve years later, he doesn't think much has changed.

"Since 1906, the Bay Area's only experienced one big earthquake: Loma Prieta in 1989," said Brocher. "So in the last hundred years, we've only had 15, 20 seconds of strong shaking. That's not much over a hundred years."

During that century, much of the infrastructure of the Bay Area was built: the freeways, the bridges, the skyscrapers in San Francisco, the continuous band of homes and businesses along the Hayward Fault. Brocher contrasted this with the half-century before 1906, when earthquakes measuring in the magnitude five to six range occurred every two or three years. Brocher thought that if these kinds of earthquakes happened more often, it would spur greater preparedness.

tombstone_fig06Brocher opened a drawer in his desk and pulled out a booklet called "Putting Down Roots in Earthquake Country," a guide describing the region's seismic situation and how residents can strengthen their homes. He flipped to a chart showing the number of known earthquakes higher than magnitude 5.5 since 1836. Each earthquake was represented by a rectangle that indicated its size. The largest rectangle was in 1906. The 1868 and 1989 earthquakes also figured prominently. From 1928 to 1968, there were no notable earthquakes at all. The timeline stretched into the future, showing a 62 percent probability of at least one earthquake of magnitude 6.7 or higher by 2032.

"We call this the tombstone diagram," Brocher said.

The Claremont

"Any reason I can't park here?" Stoffer asked as he stopped his car in what was clearly not a parking spot. The Claremont Resort and Spa nudges against the fault for about a fifth of a mile and he wanted some pictures of the building. He had navigated through a couple of small lots on the Claremont property, but all were full. He ended up on a triangular wedge of asphalt on one of the hillside lots overlooking the building.

Stoffer stepped out of his car to a commanding view of the shimmering white hotel: white walls, white roof, white tower. He set up his tripod with the dual cameras and leaned back, squinting at each of the cameras. He snapped a pair of photos for his field guide. I asked him if he had made the camera rig himself. "Oh, yeah," he answered. Then joked, "Boredom." Stoffer has been shooting 3-D photographs for years. One of his biggest projects is a web site highlighting the geology of the Southwest's national parks. His office is like a museum of fossils and crystals

he's collected over the years. On one wall, over his desk, is a mounted jackalope head. It wears a pair of red and blue 3D glasses.

Stoffer headed down the hill to the entrance. Valets scurried under a green awning, helping new arrivals with their luggage and their cars. A stylish young woman hurried out of the building, talking into her cell phone about a spa appointment. Stoffer walked past the valet station to what looked to be a small maintenance passage. According to his map, a known trace of the fault was less than a hundred feet away. He noticed some cracks in the wall, then leaned close and looked along the plane of the wall. It was slightly warped. A nearby cement planter appeared to be pulled apart. And, in the valet parking lot, between a pair of late-model Mercedes sedans, Stoffer spotted what he called a pull-apart offset, creating a tiny rift in the fresh blue-black asphalt. None of this was definitive, but all of it, as far as Stoffer was concerned, was highly suspect.

"It's a tough game to find creep movement," a geologist named Jim Lienkaemper said one afternoon in his office at the USGS. The evidence around the Claremont, for example, has always been "kind of iffy stuff." Lienkaemper has been studying the Hayward Fault for 20 years. A fresh printout was taped to his door. It was a graph covered with little hieroglyphics, the product of his latest Hayward Fault survey. Each fall he maps it again, surveying the infinitesimal distances that different sections of the fault crept during the previous year.

Over the last few millennia, the earth along the fault has moved an average of about nine millimeters every year, almost four inches. That number is the combined movement from both the gradual creep and the abrupt slip along the fault from a quake. Measuring the amount of creep at a given segment of the fault gives an idea of how much movement might occur in an earthquake. In other words, if Lienkaemper measured nine millimeters of creep each year along some segment of the fault, he wouldn't expect major slip there during an earthquake because all of the tectonic energy was being released. But the average creep rate along the Hayward is about 4.5 millimeters each year, not far enough to release all that stress. In a big earthquake, he speculated that sudden ground movement of a meter or more might be seen on the surface.

The crack Stoffer found at the Claremont could be another, unmapped trace of the fault. Lienkaemper acknowledged that he can only map the traces he knows about. There are always undiscovered traces. "We'll know when the Big One comes," he said. "We'll have a lot of new stuff to map."

Back in the Claremont parking lot, Stoffer approached the valet station. An attendant asked if he could be of assistance.

"Do you know where the Hayward Fault is?" he asked the valet.

The valet looked puzzled and thought for a moment. He scratched his head. "Doesn't it run through Cal Stadium?" he asked.

Stoffer grinned and swung his arm toward a spot beyond the Mercedes sedans. "It's right there!" he said. The valet smiled politely, but didn't say anything else.

"It's classic," Stoffer told me soon after. "He works there and he doesn't even know."

* * *

The 1868 Earthquake Alliance held its April 2008 meeting in an Oakland building undergoing a seismic retrofit. In the lobby, plywood and plastic sheeting was scattered along the walls. Inside of a conference room, thirty people had gathered to talk about the Hayward Fault. There were several geologists in attendance, including Tom Brocher, Jim Lienkaemper, and Phil Stoffer. Some people were from local businesses, others from local governments. One was a newspaper reporter. Mary Lou Zoback, from Risk Management Solutions, talked about the property loss figures from a hypothetical quake. She added that the worst damages were likely to occur in the among the poorest populations, and that disaster planning needs to account for the numerous languages spoken by the people who live in these areas.

Brocher, as chair of the alliance, discussed plans for the October 2008 commemoration of the 1868 earthquake. The event would take place at the Mission San Jose in Fremont, at the southern end of the fault. Exactly 140 years earlier, the morning earthquake destroyed the mission's church. The anniversary would be marked at the precise day, hour, and minute that the quake struck. "And of course," Brocher said with a grin, "we expect every member of the alliance to show up at 7:50."

"Ouch," said one of the attendees. "It's better than 5:12," countered Zoback, to laughter. She was referring to the annual 1906 commemoration in downtown San Francisco—timed to coincide with the early morning moment of the 1906 quake. In 2006, Zoback, then at the USGS, held the same regional coordinator position that Brocher has now, and was a leader of the 1906 Earthquake Centennial Alliance, established for the same reason as the 1868 Alliance.

Brocher declared that he wanted to try educating the public about preparation in new ways. He wanted awareness events to be more fun. He floated the possibility of hiring an airplane to fly above the fault, pulling a banner that said, "Drop, Cover, and Hold." These are the instructions for what someone should do during an earthquake: drop to the floor, take cover under something like a table, and hold on until the shaking stops.

One of the businessmen said that Brocher would have to make it clear this was an educational message, not a warning. Otherwise, he worried, people would expect something to drop out of the plane.

Brocher grinned again. "Obviously we haven't thought this all through yet."

According to a 2007 Bay Area Red Cross survey, 83 percent of the region's population is not prepared for an emergency. While government and large institutions like the University of California have been working to upgrade facilities and infrastructure to ride out a big quake, Zoback and others point out that while this may sound reassuring, the projects aren't complete. The most visible example is the new eastern span of the Bay Bridge, which is scheduled to open in 2013—24 years after the Loma Prieta quake exposed its vulnerability.

Meanwhile, Ronald Hamburger, the structural engineer who wrote about which buildings might fall in the 1996 scenario, cautions that the situation among privately owned buildings is far from ideal. He admitted that his own home, two thousand yards from the San Andreas Fault, hadn't been upgraded for a large earthquake. When he bought the house, he decided at the time that the risk of having an earthquake while he owned it, and with the amount of money he had at the time, didn't warrant the expenditure.

It was a sentiment that Zoback had discussed with me. Preparation means thinking through a kind of cost-benefit analysis. "There's a lot of upper middle class folks who have put in granite countertops and say, 'Yeah, I'll invest in retrofitting. Oftentimes what it costs to upgrade your structure is the same as what it costs to put in granite countertops."

Two decades after buying his home, Ronald Hamburger changed his mind and decided to install seismic upgrades in his home. Hamburger was remodeling his kitchen and in the process would install shear walls to strengthen his house against shaking. I asked him if he might also be installing granite countertops.

"We are," he answered. "A couple hundred bucks a foot." I mentioned Zoback's analogy. "Could be done for about the price of granite countertops," he repeated, thinking it over. "Probably true. I am planning to do both."

But even basic preparations are out of reach for some. Said Zoback: "There are a lot of people who have trouble putting food on the table, so when you talk about making kits that include food and water, some people may say, 'We need that food now.'"

So one size does not necessarily fit all in terms of disaster preparation. (When I asked Zoback what the ultimate preparation would be, she thought for a moment, then wryly responded, "A second home in the Sierras.") To someone like Ana-Marie Jones, that is the elephant in the room. She keeps a little pink plastic elephant stuck to the window of her office as a reminder.

Jones is the director of an Oakland organization called Collaborating Agencies Responding to Disasters. Despite the name, she has chosen not to participate in the 1868 Alliance.

She helps educate what she refers to as vulnerable populations. Her long list of the vulnerable includes people with physical and mental disabilities, immigrants, single parents, the elderly, the homeless, pregnant women, even tourists. Jones believes most advice is tailored for stable families who own their own homes. It doesn't take the full range of populations into account.

Jones credited Brocher and Zoback, in particular, with trying to make the alliance's education campaign appeal to more people. But one problem, she said, is that the message is coming from people who are expert in the threat. "It comes off as a high fear-based campaign," she said. "Here we are after 1868, the time span is 140 years between great big earthquakes, this year is 140. It's that kind of thing."

Fear, to Jones, is bad strategy. It shuts people down. She keeps extra copies of a study by the American Red Cross published 16 years ago that concludes that using photos of destruction increases avoidance and denial behavior, keeping people from preparing for future disasters.

"I don't believe you could come here, invest in a home, buy a car, fall in love, and have a happy, happy life, if, every moment of that life, you had to be sitting here thinking, 'Any minute now, the earth could open up. I could lose my home. My friends could die.' I just don't believe we can sustain that," Jones said. She started working full-time in preparedness education after the 1989 earthquake. Before that, she spent a decade in advertising and market research. That's the approach she believes will work.

"How would you sell this sucker? You would never try to sell fear," she told me. "You would never try to scare people into doing something that they have the right to say no to." She cited a fear-based campaign that works—the push to get people to wear safety belts in order to avoid injury in a car crash. It works, she said, because if you aren't wearing one, you can get a ticket. You're punished. "What can I do to you if you don't take on preparedness? Nothing."

She is convinced that awareness campaigns should separate preparation from the threat of disaster. In the process, it should make preparation appealing. She compares this to advertisements designed to get you to brush and floss your teeth. "They don't show you rotting teeth. They show beautiful people with beautiful teeth." Her message is "prepare to prosper."

She encourages people to start small and build on decisions that leave them feeling more confident right away. She distributes tiny flashlights and whistles that can be attached to key chains or backpacks. She wore a necklace with a whorled green and white globe hanging from it. When I asked her about it, she took it off and opened the globe. It was a locket made from silver and glass. Inside was a $100 bill.

Still, it is difficult to divorce the preparation from the disaster. Pam Grossman is a compact grandmother who lives in the Berkeley hills. One afternoon, she unlatched a couple of padlocks on the gray plastic shed near her garage. Her husband, Elmer, sat on a porch nearby, eating a sandwich and reading a copy of the New York Review of Books. She opened the doors and began to shuffle through its contents. "You can't have enough masks, goggles, and gloves," she said. Grossman picked up a nozzle that, attached to a garden hose, would create a high-pressure flow to fight the fires that flare up after a quake. "But the problem in Berkeley," she said, "is the pipes are more than 100 years old. So they'll probably disintegrate." Mylar blankets, hard hats, and a medical kit sat on the shelves. On the ground, there was a 10-horsepower generator as well as some water containers. Grossman hefted a tool called a "come along," which she expects will be used to lift large objects like tree branches or fallen beams. She put that down and picked up a Reliance brand "luggable loo"—a plastic toilet seat that can be fixed to a five-gallon bucket.

Grossman received most of these supplies from the city of Berkeley because she manages her neighborhood's emergency response team. It includes 45 households and has been active for 20 years. They are organized under the premise that emergency crews will be too overwhelmed after a quake, and so the neighbors will have to step in. Grossman and her husband, a retired pediatrician, make up the medical team.

While Grossman has made it her mission to visit other neighborhoods and help them organize, she isn't sure that's enough. I asked her what she thought would motivate people to take preparation seriously.

"I think it's gonna take a serious earthquake," she said. Then she acknowledged that this would be too late.

Nearly every person I talked with echoed that sentiment. It would take a good-sized shaker up here to wake people up. Or a really strong one that, one expert hoped, would be far away in Southern California. And consistent, the way they were in the 1800s. Otherwise? "What I've experienced over thirty-odd years of practicing in this area," said Ronald Hamburger, "is that people tend to become very concerned and focused for a period of 12 to 18 months after a significant event. Then their interest falls away exponentially with time. It's now been 20 years since the last earthquake in the Bay Area and peoples' interest is pretty low."

But Jones bristles at the fatalism built into this perspective. "They say that all the time," said Jones. "We said that after Loma Prieta, too. That's a reason why a lot of people don't want to hang around with the disaster folks. Because they say, 'Oh, what we need is a really good earthquake to shake things up. What we really need is a little earthquake that happens every eight months or so to keep people moving around.' Do you know how creepy that sounds to many people? And that's what they say, all the time."

As for neighborhood emergency response teams, Jones acknowledged that they can be useful, but difficult to sustain. "It's hard to get people wanting to think about disasters," she said.

Grossman seemed to acknowledge as much as she stood in her doorway, seeing me off. "If I weren't around," Grossman said, "people would slack off. I've got to keep lighting fires under them. Every neighborhood needs one of us. Or preferably two."

Cal Stadium
Phil Stoffer in the stadium
Phil Stoffer entered the Berkeley campus with a trick up his sleeve. He pulled his car up to the lot attendant just outside of the university's Memorial Stadium. "I'm a geologist," he told the attendant, who shrugged and waved him in.

Stoffer walked into the northern end of the stadium, pausing to admire (and photograph) a vicious crack that cascaded down an interior wall. He continued onto the field, where he took a photo behind the goalpost, then walked to the southern end of the stadium. At section KK, he began to climb the bleachers.

Stoffer next to the expansion jointStoffer stopped on the very top, at a long yellow bench. Row 74, section KK. Behind the bench was a five-foot cement wall, the outer rim of the stadium. It was split vertically into two pieces. This wasn't a crack, though there were cracks running alongside. It was an expansion joint built into the stadium structure. The Hayward Fault, above which the stadium is built, had taken full advantage. Since the stadium opened in 1923, the fault

had slowly pulled it apart and opened a gap wide enough for a fist. The top was capped by a piece of rusty metal attached with rusty bolts to the concrete. A spectator could look through the wall, past the concrete and a naked piece of rebar, and see Oakland to the south. Stoffer paused to catch his breath after the climb up. He was excited, and seemed genuinely happy.

"That," Stoffer said, "is probably the most famous spot on the Hayward fault." He chuckled. "It's just a ragged, broken gash."

And he took a picture.