Excerpt from

"Hearth Surgery"

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Early in October, Still and I flew to Guatemala to visit the world's longest-running stove study. The village of San Lorenzo, where it's based, is in the remote western highlands, close to nine thousand feet above sea level. It feels like one of the world's forgotten places—its houses, made of mud and straw, cling to terraces that look out over plunging valleys and volcanic peaks—yet its cooks are among the most closely observed in the world. Walk into many local kitchens, and you'll find, attached to the walls or in the children's clothes, an array of electronic sensors and transmitters. Some measure particle emissions; others are motion detectors or carbon-monoxide monitors. Next to the chimney, on top of the stove, is a piece of black duct tape with a small silver disk beneath it. Plug the disk into a Palm Pilot, and it will tell you exactly when and for how long that stove was used in the previous month.

In seventeenth-century England, when a stove maker wanted to test a new design, he'd soak a piece of coal in cat's urine and throw it into the fire. If the stench went up the chimney with the smoke, the design was deemed a success. Stove-testing is more of a numbers game now: minutes to boil, grams of fuel, milligrams of black carbon. Yet the practical effects of those numbers aren't always clear—especially on the emissions side. "We have no idea how low you have to go before you get the majority of the health benefits," Jacob Moss told me. "Is it peak exposures you want to get rid of, or is pollution a steady-state thing? Rocket stoves still have a whole slew of emissions that are an order of magnitude higher than E.P.A. standards." Cutting them in half, or even by two-thirds, may not be enough, he said.

The study that Still and I observed was aimed squarely at such uncertainties. Its detectors were the work of Kirk Smith, a professor of global environmental health at Berkeley and one of the world's leading authorities on indoor air pollution. Seven years ago, Smith and a team of students, researchers, and Guatemalan collaborators began tracking more than five hundred local families, all with pregnant mothers or infants less than four months old. The families were divided, at random, into two groups. Half were given plancha stoves with...
chimneys; the other half continued to cook over open fires. (After two years, when the first phase of the study was over, the second group got stoves as well.) Every week, Smith’s team would give the families a medical checkup and download the data from its sensors. In this way, they could track their pollution exposure and its effects in real time. “My wife likes to say that most men spend their lives watching women cook,” Smith says. “Her husband has managed to make a career of it.”

Smith is a rumpled sixty-two-year-old with tousled gray hair and eyelids as heavy as a basset hound’s—he seems both tireless and perpetually short of sleep. When Still and I drove up to his site with him from Guatemala City, he spoke absently, and almost continuously, for six hours about public health.

(Last June, for a vacation, he took his wife and daughter to Chernobyl.) San Lorenzo is a six-hour flight plus layover on the red-eye from San Francisco, followed by a vertiginous trek, by truck or multicolored bus, up whasing mountains roads. For three years, Smith made the trip every month. His funders left him little choice, he told us.

“I’d go to an air-pollution conference and show them my measurements, and they’d say, ‘Good Lord, these are orders of magnitude higher than in our cities! And these are the most vulnerable populations in the world. Just go out and fix it!’” Instead of funding stove projects, though, they’d pass him along to the next agency. “So I’d go across the street, to the international health meeting,” Smith went on, “and they’d say, ‘Well, Mr. Smith, you have a pretty convincing problem, but we have seven dollars a year per capita. Do you really expect us to take a dollar out of our budget for vaccines? We need to be damn certain that we can make a difference.’” The pharmaceutical companies had dozens of randomized trials to back up their claims. What did Smith have?

San Lorenzo is his answer. The study, which was funded by the N.I.H. in 2001, now generates so much information that Smith needs two full-time workers to enter it into computers. On the morning after we arrived, Still and I joined the team on their rounds through the village. While Still scrutinized the stoves and suggested ways to improve them (he and Smith were hatching plans for a more efficient “hyper plancha”), I sat and watched the women cook. Diminutive and shy, in their bright embroidered blouses and tapestry skirts, they quietly answered questions as their children clutched their legs or peeked out from behind doorframes. The houses were low-ceilinged and bare, with earthen floors, corrugated roofs, and a tree stump or two for furniture. Some had sheaves of Indian corn drying from the rafters, or raised eaves that allowed a little light to leak in. A field hand in San Lorenzo makes about twenty dollars a week, Smith said—“Truth be told, they haven’t recovered since Cortez.” But in most of the houses with stoves at least the air was clear. In those with open fires it hung so thick and noxious that the walls were blackened, the joists and beams shaggy with creosote. It was like sitting inside a smoker’s lung.

Near the end of our rounds, we paid a visit to Angela Jiménez, a small, sharp-featured woman who was part of Smith’s original control group. Jiménez is thirty-five and has five children, including four-month-old twins. When we walked in, she was simmering a pot of corn tortillas and sautéing a recado de pescaido—a thin brown sauce made with dried fish and cornmeal, ground together on a slab of volcanic rock. Smith’s team had given her a stove six years earlier, but she hadn’t bothered to maintain it. The clay tiles and steel griddle were pocked with holes, and smoke was billowing into the room. On the wall behind the stove, the team had hung a poster explaining the dangers of carbon monoxide, but the words were too covered in soot to be legible.

We were getting ready to leave when Jiménez’s nine-year-old son, Wilder, lumbered in with his baby sister, Milvía, in his arms. She was tightly bundled in blankets, with a blue-and-white knit cap on. Her face was covered in dried phlegm and she was crying hard, with a steady, wheezing cough. Jiménez lifted her up and laid her against her shoulder. Her daughter had been sick for eight days, she told us, and was running a fever. “You should take her to the clinic,” Smith said. “Eight days is a long time at that age.” Jiménez looked at him with hooded eyes and turned back to the stove. If she went to the clinic, they’d just

That’s not what I heard. I heard they’re keeping the pig and getting rid of five chickens.
send her to the hospital, she said. “And that’s where people go to die.”

Smith later prevailed upon Jiménez to let his team drive her to his clinic, where a physician gave both infants a diagnosis of severe pneumonia. Milvia was hypoxic: her lungs were so full of fluid that they couldn’t get enough oxygen into her blood. Her twin brother, Selby, was even sicker: his blood was only eighty-two per cent oxygenated, and his lungs made crackling noises under a stethoscope. “He could pass away tonight,” Smith said. Pneumonia is the leading killer of children worldwide, and San Lorenzans are especially susceptible to it. They’re so malnourished that their height, at eighteen months, is already two standard deviations below the norm. And their immune systems are further weakened by the toxins in wood smoke. On average, Smith has found, the children in the village get pneumonia every other year.

“So this is the bottom line,” he told me that night, bringing up a graph on his laptop. “This is seventeen years of applying for grants, seven years of research, three and a half million dollars, and me coming down here for a week of every month.” Thanks to his electronic sensors, Smith knew his subjects’ cooking habits in microscopic detail. He knew when they lit the stove but left the room while it was burning. He knew how much smoke was in the air when they were cooking and how much carbon monoxide was in their breath. And by combining such data with their weekly medical records he could show, for the first time, how the risk of disease increased with exposure—what epidemiologists call a dose-response curve.

“For groups like the Gates Foundation and USAID, the metric is cost-effectiveness,” Moss had told me. “How many people are you going to save with a hundred million dollars? That’s what they want from this field, and they don’t have it yet.” Until now, Smith had data on half a dozen diseases that a decent stove could help prevent (it could lower blood pressure about as much as a low-salt diet, for instance). But the most dramatic numbers were for pneumonia. The graph on his laptop had an x-axis for exposure and a y-axis for disease. In between, the data followed a steeply rising curve. The children who inhaled the least smoke were between sixty-five and eighty-five per cent less likely to contract severe pneumonia than those who inhaled the most.

“Those numbers are as good as for any vaccine,” Smith said. The plancha stoves cost about a hundred dollars each, yet they were a bargain in public-health terms. “In our country, we pay forty thousand dollars per year of life saved,” Smith said. “Even if you take the lower end of the benefit, this would cost at most a few hundred dollars per life-year. It’s a no-brainer.” In a country like India, he and a team of co-authors later estimated, in an article in The Lancet, stoves could save more than two million lives in ten years.

Smith’s data may be good enough for the Gates Foundation, but the harder part will be convincing local villagers. Most of the San Lorenzans liked their stoves, and maintained them well enough. But they considered the smoke from cooking more of an annoyance than a threat. (In Africa, some even welcomed it as a defense against flies and mosquitoes.) “These kinds of correlations just aren’t that easy to make,” Smith said. “Think of cigarettes. They kill one out of two smokers prematurely—no war has ever had that effect. Yet famous scientists have died saying there is no connection.” To imagine cooking as harmful is an even greater leap. “It’s not cyanide,” Still said. “They can always think of an eighty-nine-year-old who’s been cooking over an open fire all her life. And Grandma’s doing just fine.”

The best examples of this insouciance, in San Lorenzo, were the wood-fired saunas that most of the villagers used. The tradition dated back to the ancient Mayans, who would heat rocks over an outdoor fire and carry them into a stone bathhouse. The modern version, known as a chuj, was just a mud-caked hut about the size of a large doghouse. It had an open fire inside, a pallet to lie on, and a blanket to seal the door. A chuj was essentially a human smokehouse, yet the same villagers who swore by their plancha stoves—including Vincente Tema, one of Smith’s Guatemalan staff—took sauna baths once or twice a week for half an hour. (The baths were especially good for pregnant women, they said.) When I asked Tema if I could try his chuj, Smith shrugged. I might want to take a carbon-monoxide monitor with me, he said.

The experience wasn’t altogether unpleasant—there are worse things, apparently, than becoming a giant slab of bacon. But by the time I stumbled out, sixteen minutes later, my head was swimming. When Smith later downloaded the monitor’s data at his office, it showed the carbon monoxide in the chuj spiking to five hundred parts per million, then abruptly levelling off. The program wasn’t designed to show levels any higher than that, he explained. “Oh, buddy,” Still said, staring at the screen. “If you’d gone to a thousand for ten minutes, you’d be in a coma now.”