Housing in the vicinity of Pittsburgh's new highway, June 1950.

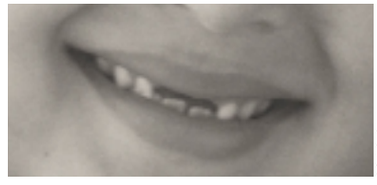
HERB NEEDLEMAN TOOK ON THE DISEASE OF WHERE WE LIVE AND WORK | BY REBECCA SKLOOT

HOUSES OF BUTTERFLIES

After Frank Durr died in a straightjacket in 1924, workers at the DuPont Deep Water plant thought they knew what killed him. They figured it was the same thing that killed William McSweeny—whose sister called the police for help after he went home sick from his work at a similar Standard Oil facility, then woke up the next morning violently insane. He died in a straightjacket, too. Fifteen others did as well, and the dead men shared one more feature: They all had worked in a House of Butterflies—a building for tetraethyl lead synthesis—so named because its workers were known for brushing hallucinated insects from their bodies.

In the early 1920s, in an attempt to outdo Ford's Model T, General Motors mounted efforts to find an agent that would quiet the Cadillac, whose knocking engine kept it lagging in popularity. What they came up with—an old compound Germans had developed called tetraethyl lead—silenced knocking engines and inspired a burgeoning new product: Ethyl Gas. But shortly after mass production of leaded gasoline had begun, workers in Deep Water, New Jersey, and at two other plants started developing a mysterious and often fatal illness. New York and New Jersey responded quickly, banning leaded fuel and ceasing its production at the plants, but their action was only temporary. After a six-hour Surgeon General's meeting, the ban was lifted, production resumed, and lead soon found its way into everyday use, fueling more than half a century of heated debate.

Twenty-five years after the deaths of Durr, McSweeny, and others, the 2 p.m.-break whistle echoed along the Delaware River behind Deep Water, and Herbert Needleman filed out with the other workers. Needleman, a second year medical student at the University of Pennsylvania paying his way through school, had soaked through his clothes in the plant's heat, which usually topped 100 degrees by early morning. He peeled off his elbow-length rubber gloves and headed outside for a cigarette. Every day when the break whistle blew, Needleman and



PHOTODISC

PHOTO OF GIRL | LISBOHN, CARNEGIE LIBRARY
PORTRAIT OF NEEDLEMAN | FRANK WALSH

other men would swarm across a field, far from the plant and its explosives, into wooden smoking shacks with glowing cigar lighters embedded in the walls. There, Needleman would smoke and check out his coworkers. In the corner, a few older men sat staring blankly into space, moving slowly and clumsily. If they spoke, their voices were distant and empty. One day, when Needleman asked other workers the story behind these men, they all shook their heads. "Oh yeah," one told him, "those guys worked in the House of Butterflies."

Needleman joined the University of Pittsburgh School of Medicine in 1981, leaving Harvard University to join Pitt's Departments of Psychiatry and Pediatrics. Calling professor Needleman a leader in the field of lead research would be an understatement. (The champion of preventive medicine has long since kicked the smoking habit, by the way.) He has spent much of his career attempting to convince others that exposure to lead, even at low doses, has tragic effects on individuals and society. Though few deny that high doses of lead are toxic, its low-dose effects have been passionately debated. If you ask Needleman where arguments against the danger of low-dose lead exposure come from, he'll tell you it's the lead industry—an entity he has fought through several turbulent decades. The battle starts with Needleman's first academic paper, and spans through scientific misconduct charges brought against him (by researchers who served as paid expert witnesses for the lead industry), to his work today.

As for the scientific misconduct charges, the committee that investigated him regarding the allegations directed Needleman to correct and clarify published reports of certain methodological aspects of his work and to make available to any interested scholars his complete data set on his tested subjects. More importantly, the committee asserted that the conclusions from his data were robust. Needleman had not engaged in scientific misconduct. Further, his early findings on subclinical lead exposure have since been confirmed by similar studies in Australia and elsewhere. And his efforts to de-lead America in the name of public health, even in the face of scalding controversy, have won him prestigious honors such as the Dana and Heinz Awards.

As for halting the effects of low-level lead exposure, Needleman has had a few victories, but at 73, it's a fight that still consumes him.

Rubbing his eyes gently, Needleman lets out a deep sigh when he talks about lead and its effects. "Lead does so many things to human biology, we don't even know which ones are most important," he says. It affects neurotransmitters responsible for nerve conduction, causes leaky capillaries, kills brain cells, affects RNA transferase and transcription of the genome, and that's just an abbreviated list. "There are thousands of articles out there," he says, "and so many effects that could be critical, we don't really know what's what," and then he pauses. "We just know that the more you look for brain effects, the more you find them, even at very low doses."

Needleman recalls how in 1960, according to the Centers for Disease Control and Prevention, a child needed at least 60 micrograms of lead per 100 milliliters of blood to be officially identified as poisoned. Back then, 20 percent of inner city children had blood lead levels of 40 to 50 micrograms per 100 milliliters, and they were considered normal. This made no sense to Needleman. *Listen,* he said, *if we know for a fact that high-dose lead poisoning causes obvious problems—like coma, retardation, and death—why should we assume that lower levels cause no injury to a child's brain?* He has asked this question repeatedly for about five decades. Almost every time he does, he designs a study to examine it from a new angle. (Today, the toxic lead level is defined as 10 micrograms per 100 milliliters, and still 21 percent of inner-city children have lead levels above that, according to Needleman.)

In the '70s, Needleman's community mental health office was what used to be a living room in an old brownstone in an impoverished section of Philadelphia. Each morning Needleman stared through his office window into a primary schoolyard across the street. It was full of poor kids, mostly minorities, who lived in turn-of-the-century houses with peeling lead paint. As they giggled and ran by his window, Needleman started to think to himself, *How many of those kids aren't going to make it because they are lead poisoned? And what other damage might they suffer from lead's toxins?* To find out, first he needed a better measuring stick. Lead is a bone-seeker—like calcium, it migrates into bone, where it accumulates. So if a child were exposed to lead during, say, the first three years of life, a blood-level test at four might not show any lead. At the time, the only accurate test of long-term lead exposure was a bone biopsy, which would not have been acceptable for hundreds of seemingly healthy children. But when a child loses a tooth, Needleman realized, it's like a spontaneous, pain-free biopsy. He got a $500 grant from the federal government, took a chunk of it to the local bank, and converted it into silver Kennedy half-dollars. Then he had little badges made up that said "I gave." With his half-dollars and badges, Needleman worked with the schools to collect teeth from several locations—some from Philadelphia's "lead belt" on North Broad Street, a hot spot for poisoning, others from areas that rarely reported lead poisoning. Those teeth, Needleman established, were good markers for lead levels.

That got him an invitation to Harvard, where he would show the world lead's subtle destructive powers. In 1979, in a study on Massachussetts children, he determined their life-long accumlation of lead and examined whether that correlated with their IQs. He found that children with higher accumulations of lead also had, on average, five or six fewer IQ points than those from the same neighborhood, ethnic background, and economic status with lower accumulations.

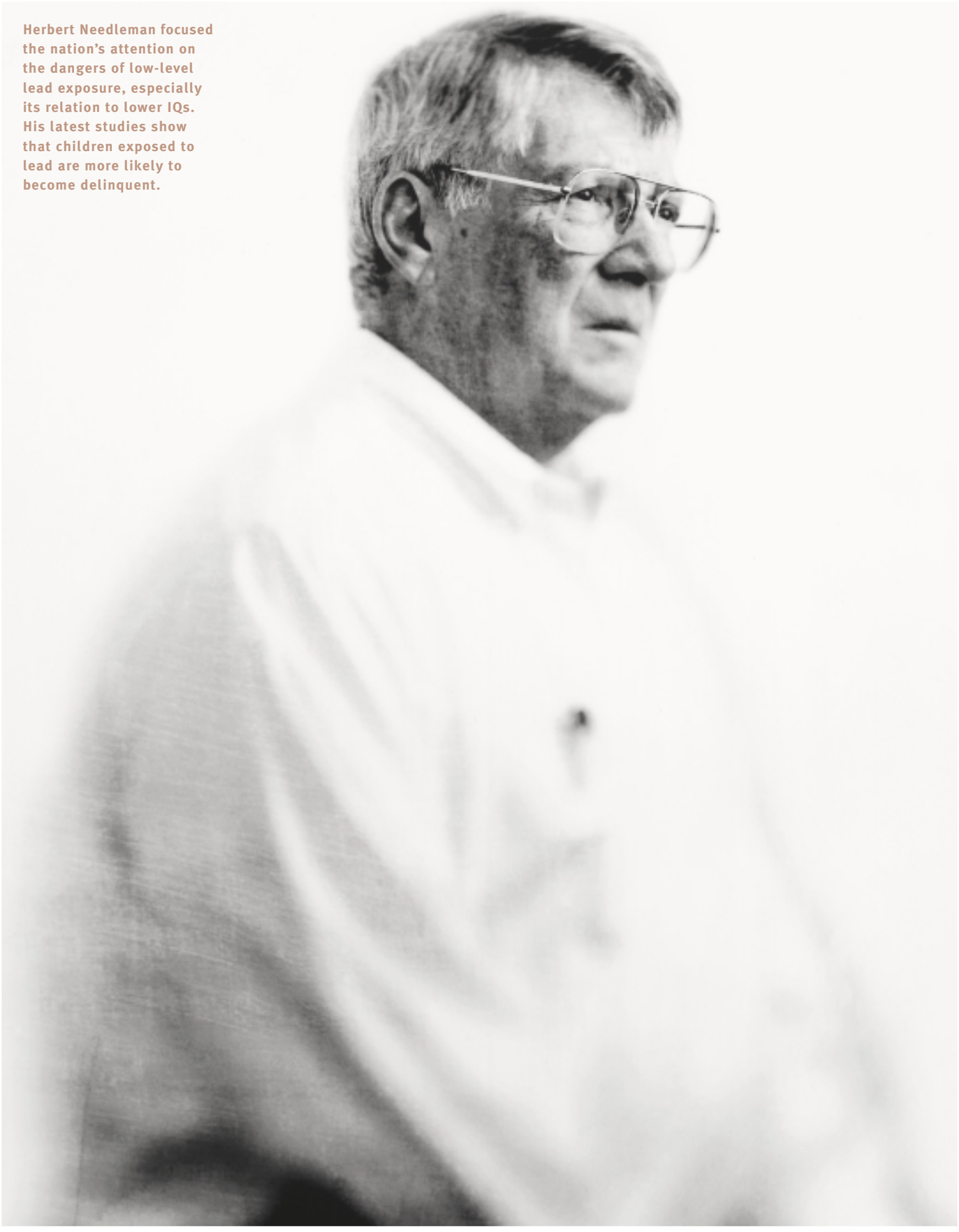
"Her disease was where she lived, and why she was allowed to live there."

"That study," says Philip Landrigan, professor and chair of community and preventive medicine at Mt. Sinai School of Medicine, in New York, "really changed the whole way the world thinks about lead poisoning."

"He really made the world consider the possibility that subclinical exposure to environmental pollutants could have a serious societal impact," notes David Bellinger of Harvard Medical School, who has collaborated on studies with Needleman.

"These low-level exposures may not result in a child who is clinically ill, but he showed that there is a more subtle impact: It reduces the child's quality of life, and when the effect of lead is projected across the whole population, it has a cumulative impact that's really substantial. It's shifting the whole distribution of cognitive level a bit toward the lower end." Needleman calls this the subtle dumbing down of America; he doesn't take it lightly.

When people hear the story of Needleman working at Deep Water and seeing lead-poisoned workers from the House of Butterflies, they are likely to say, *Oh, that explains why he's anti-lead.*



Herbert Needleman focused the nation's attention on the dangers of low-level lead exposure, especially its relation to lower IQs. His latest studies show that children exposed to lead are more likely to become delinquent.

But actually, it doesn't. For Needleman, the significance of that day at Deep Water did not hit him until years later, after an experience with a young Hispanic girl changed his understanding of lead poisoning and its causes.

It was the early 1960s, Needleman was a self-proclaimed "cocky" resident at Children's Hospital of Philadelphia, and a young girl, we'll call her Vanessa, was admitted to his ward with severe lead poisoning. She had eaten the lead-based paint peeling from her inner-city home, and her story was all too common. Her brain had swollen to a point where she was dangerously near death. She didn't cry, didn't smile, just lay there, comatose. Needleman treated her with EDTA, a chelating agent and the only drug available to counter lead poisoning. Soon, she woke up crying, and Needleman breathed a small sigh of relief. Within a few days, she smiled the sweetest smile Needleman can remember. He felt proud, even smug. When he knew the girl was going to make it, he turned to her mother and calmly told her she had to move from her home.

"If Vanessa eats more paint," he said, "there's no question she'll be brain damaged."

Her mother shot Needleman an angry look and snapped, "Where can I go? Any house I can afford will be no different from the house I live in now."

Needleman's smugness vanished. "I realized," he says, "that it wasn't enough to make a diagnosis and prescribe medication. I'd treated her for lead poisoning, but that was not the disease—the disease was much bigger and caused by forces embedded in the child's life. Her disease was where she lived and why she was allowed to live there."

Historically, childhood lead poisoning has been a problem for minorities and low-income families. "There's much more lead in poor, black, and Hispanic neighborhoods because of the kinds of houses they live in," Needleman points out. "There are middle-class white kids who are affected, but the rate is five to six times higher in the poor neighborhoods." Today, old paint is the most important factor, but for several decades, lead in gasoline compounded the problem. After the deaths at Deep Water and other plants, there was a brief moratorium on leaded gasoline. Soon after though, lead became a major component of everyday life in America, most notably as an additive to gasoline and paint. In 1973 alone, as Needleman puts it, "200,000 tons of lead were blowing out of the exhausts of American cars each year." He thought this was a crime. The more studies he conducted, the more deleterious effects from lead he found. Through governmental committees, editorials, and other means, Needleman and other researchers fought against leaded gasoline for 40 years.

"Dr. Needleman was a key figure in persuading the Environmental Protection Agency to take lead out of gasoline," says Landrigan. "That single action of taking lead out of gasoline has brought a 90 percent reduction in blood lead levels in children of this country."

Needleman wants to do the same for leaded paint. He says, "See, if you de-lead a house, that house is safe forever. It's not just the kid who's living there you're protecting—it's any kid who moves in. And in the poor neighborhoods, during the lifetime of that house, there may be 10 different families in there, so you're protecting all those children." Then he pauses.

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"In a way," he whispers, "it's a bargain.

"People say we can't afford to do it. We can't afford not to do it. The actual cost-benefit analysis done by the Public Health Service shows that, in terms of avoided health costs and special education fees, there will be a $28 billion savings for de-leading all the houses. So there are a lot of good reasons to do it: moral, ethical, and practical reasons."

When moral and ethical motivations are involved, it seems Needleman will go to any lengths to right a situation, and it's not unlikely for him to upset a few people along the way. As an antiwar activist during the Vietnam War, for example, he traveled overseas to rescue wounded Vietnamese children and bring them to the United States for medical care. He and Benjamin Spock, the famous pediatrician who was a mentor for Needleman, spent their share of time together, including one night in jail for an antiwar protest. During all of this, Needleman kept up his fight against lead.

While at Harvard, Needleman studied newborns, taking blood from umbilical cords to determine prenatal lead exposure. He found that even at very low doses, infants born with higher lead levels had slower neurobehavioral development than those from the same backgrounds with less exposure in the womb.

Later, at Pitt, Needleman and his colleagues reexamined kids from the famous Harvard IQ study that he had conducted 11 years earlier. Those kids, at 17- or 18-years-old, were more likely to be dyslexic, drop or flunk out of high school, and get arrested if their lead levels surpassed 10 micrograms.

Most of the lead studies to date, including Needleman's, have focused on IQ, but he doesn't think that's the most important factor. "I think lead affects attention, behavior, and impulsivity," he says, quickly pointing out that this isn't a new idea. Another mentor, Randolph Byers at Children's Hospital in Boston, first saw this connection in a few patients referred to him for aggressive behavior during the '40s. But Needleman is the first to explore this connection through in-depth studies.

In 1996, Needleman conducted his first delinquency study; it involved several hundred children. He measured their bone lead levels and collected reports of aggression and delinquency from the subjects, their parents, and their teachers. With this study, Needleman showed an association between lead and delinquency. For him, the next logical step was to see if lead affected arrest rates. He identified about 200 adolescents who'd been sentenced to time behind bars and a control group of teens from local high schools with no arrest records. He measured the lead stored in their bone, using a relatively new non-invasive technique called X-ray fluorescence spectroscopy, and found that, controlling for race and socioeconomic class, mean lead levels in delinquents were significantly higher.

"Well," he says with a tisk, "that's a lot of delinquency. And the thing about lead toxicity is, it's completely preventable." He shakes his head. "Of all the causes of delinquent behavior, this is probably the easiest one to get at. If you just take lead out of the houses, then people won't get poisoned, and a significant amount of delinquency might well disappear. Just think of what that would do for our society."

"Lead, as Herb has said so many times, is a simple problem," says Bellinger. "We know where it is, how it gets into the body, and the damage it can do. In some ways, it's a bellwether of our abilities as a society to address these problems." ■