



Quiet Hero

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One of 720 samples of rice brought back recently from China for analysis at UNH. Top, workers planting rice.

TOP PHOTO COURTESY CHANGSHENG LI
PHOTO, LEFT, BY PERRY SMITH/UNH PHOTO SERVICES



An unassuming researcher embarks on a courageous quest that changes his life forever

During the 1940s, the road through the dilapidated town of Xian, China, was rough and unpaved, dusty in the dry season, muddy when the rains came. But every morning, a small boy with a passion for learning set out from home for the mile-long walk to school. And every morning, along the way, he passed the local hospital. What he saw there haunted his childhood dreams. A line of people, most of them farmers, waited outside, hoping for treatment. Many had walked all night from distant villages. Most were visibly suffering, bowed down with enormous growths and deformities—a parade of mortal afflictions. “Everybody said it was from the soil and water,” recalls Changsheng Li, “but nobody really knew.”

Two decades later, as Li was finishing his bachelor’s degree in geochemistry at China’s University of Science and Technology, he began to suspect that explanations for the diseases he had witnessed during his long-ago walks past the hospital might be discovered through the study of biogeochemistry. Digging through existing literature, he found references to a number of endemic diseases specific to a geographic region, including the ones he had seen as a child. Abnormal legs and arms, for example, were attributed to a deficiency of sulphur; huge neck growths were attributed to iodine deficiency.

Suddenly Li knew what he wanted to do. In 13 provinces across China, another tale of human suffering had been



unfolding for several decades. People were dying abruptly, dramatically, and no one could figure out why. Named after the county in Heilongjiang Province where the first case was found in the 1940s, Keshan disease resulted in sudden heart failure. As Li pored over documented cases, he noticed the disease occurred only in certain geographic zones, and he had an inkling of how to proceed. “I had a very strong desire to help,” says Li.

In 1967, three years after graduating, the young scientist assembled a research team and headed to Heilongjiang. Instead of testing bacteria, as previous research groups had done, Li’s team tested the chemistry of the food, soil and water. Their mission was urgent. “Infants were dying in my arms,” says Li.

After two years of non-stop research, Li and his team discovered irrefutable evidence that Keshan disease was linked to agriculture practices which were leaching trace elements, especially selenium, from the soil and water. Li and his team developed a biogeochemical model designed to prove this link. Well received by the research community, Li’s work stimulated more research, and subsequent studies confirmed the environmental connection to Keshan disease.

But for people in the affected provinces, it was the early work of Li and his team that mattered most. As soon as the initial findings came in, doctors were dispatched to the countryside. The people were given selenium supplements, fields were treated with selenium-based fertilizer and years of agonizing loss came to an end.

Li was a hero—at least to those who knew him. He had made a significant contribution to his country as well as to the field of biogeochemistry. He had also embarked on a lifetime commitment to help humanity through science. “My dream was to do research in biogeochemistry,” Li says, “to study the relationship between living forms and their environment by tracking the movement of chemical elements in nature.” Li’s motivation was simple. He wanted to make a better world.

Little did Li know that his vision would propel him, and sustain him, on a journey that would take him thousands of

miles from home, through tremendous political and personal turmoil. It was a journey that would transform him from earnest student to powerful official to courageous protestor to world-famous researcher. Ultimately, it was a journey that would change his life forever.

In the beginning, though, even after the success of his Keshan research, Li was virtually unknown in China. Newspaper reports never mentioned the names of Li and his colleagues. His achievements were ignored. Instead of honoring him, the authorities tried to silence him: Li was sent to a labor camp.

The year was 1968 and Mao Zedong’s Cultural Revolution was in full swing. Intellectuals like Li, who were devoted to learning and free thought, were out of favor. Graduate schools were shut down. Countless professors were put under detention, including Li’s advisor, who was dragged out every day to be publicly criticized by the Red Guard. Angry mobs surrounded him, shouting, “Down with the anti-revolutionary academic authority.” Others were not so lucky and died of abuse or suicide.

Li, meanwhile, spent his days taking orders from the army,

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they sent him to a labor camp.**

planting rice and wheat alongside fellow students and others the regime considered untrustworthy. For two years, he was not allowed to go home. But Li refused to give up his research. Ignoring army officials, who threatened to keep him in the camp forever, Li wrote letters to his Keshan team, offering advice and support.

During his years in the labor camp, Li was sustained by ideas he had gleaned from reading. Jack London’s *Love of Life*, Walt Whitman’s *Leaves of Grass* and other books—even in their Chinese translation—had stirred in him a sense of life’s larger potential and the inherent goodness of humanity. Li, who had discovered the books as a young man, had never dared discuss

the controversial ideas they introduced. But he took their messages to heart. “I learned that people must be brave and speak out if something is wrong. I learned about the beauty of the world, the beauty of human beings, their good hearts and good spirit.”

When Li was released from the labor camp in 1970, he went straight to Xian to see his mother, who had been widowed for ten years. His father had died the same day Li had started college in Beijing. But his mother had forbidden her oldest son to interrupt his studies to come home and help. Instead, she began making matchboxes to support herself and her six children.

During Li’s visit home, he also met his wife-to-be, Ruilan Lu, a childhood friend recently released from another labor camp. In 1972, the newly married Li received a call from the Beijing government, asking him to help solve China’s massive pollution problem. “Until then, people were not allowed to say we had a pollution problem,” says Li. “It was a political issue. Pollution belonged only to capitalism.”

In reality, China’s air, water and soil, especially in cities, were seriously contaminated. Li’s team studied the problem near Beijing, where pollution and disease were occurring simultaneously. The methodologies they established were eventually adopted throughout China. But when the research began, it was, like the Keshan project, highly classified.

When the Cultural Revolution ended in 1976, Li played an active role in the intellectual rebirth of China. He participated in the first conference designed to launch a long-term plan for scientific development. He was elected to the committee on environmental science at the Chinese Academy of Sciences. And the research achievements of Li and his team were finally recognized with China’s first national scientific achievement prize.

Ignoring an opportunity for a senior position at the academy, Li surprised his colleagues and friends by going back to school as soon as graduate training resumed. “I wanted to gain more knowledge,” says Li, “especially in thermodynamics and chemical reaction kinetics, to understand how the chemical elements link life to its environment in such a harmonious way.”

During the next 10 years, Li immersed himself in academia, making up for lost time. He earned a master’s degree in en-

vironmental chemistry, and in 1985, after two years alone at the University of Wisconsin—his wife remained in China raising their two young daughters—he received a Ph.D. in biogeochemistry.

In 1987, Li received another call from the Chinese government asking him to become a senior administrator of China’s environmental protection agency. “Basically, I had to say yes,” says Li. And so he was thrust from the world of

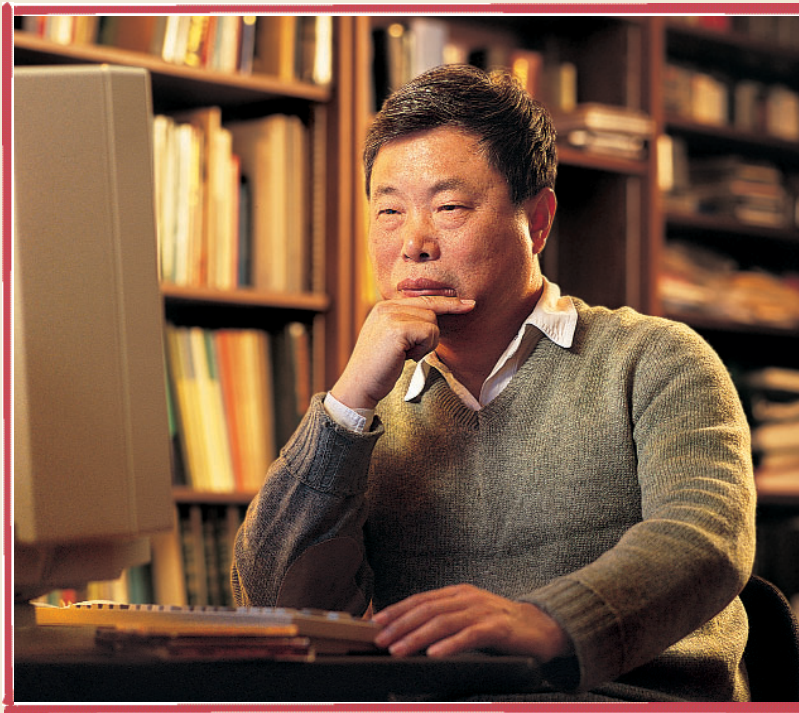
academia into the world of policy making. As relations with the West improved, Li was sent to Washington, D.C., for a crash course with the U.S. Environmental Protection Agency on how to run an organiza-

tion. And then came June 4, 1989. Li and his wife, who was in Washington for a visit, watched on television as tanks drove into Tiananmen Square, firing on pro-democracy student protestors. “We really felt like we had to support the students,” says Li. “What they did could help stem the rapidly increasing tide of cor-

ruption. We had to do something, or there would be no hope for China.” Li joined the demonstrations in Washington, and at the urging of his mostly younger companions, and in spite of the pleas of his wife, who feared for their daughters’ safety in China, the softspoken Li stood in front of television cameras at the Lincoln Memorial and voiced support for the Tiananmen Square protestors. “It was hard for me to do it,” he says. “If I was viewed as anti-revolutionary, my daughters could be in big trouble.” Li’s courage did, in fact, change his life forever. The next day, Chinese authorities called the EPA demanding Li’s return to China. Many protestors back home were already in prison. More phone calls and telegrams followed. In the end, Li chose to disobey the order to return. And with that decision, his career in China was over.

Li found himself standing at the threshold of a new life without his beloved daughters, Su Li and De Li, whose Chinese names represent their father’s two great passions, science and democracy, the very ideals that had propelled him to this point. For the next two years, Li and his wife spent most of their time trying to get their daughters, who were then 17 and 10 years old, safely out of China.

Li is grateful to the many people who helped them, including church members, several senators and even the White



“Changsheng Li is a true citizen of Planet Earth,” says former UNH colleague Robert Harriss. “The importance of producing knowledge that benefits humanity is central to his whole life.”

House. The Chinese government finally released both girls, and the family began to rebuild their lives thousands of miles from home. They were starting from scratch—no furniture, no books, none of the beloved artifacts of their life in China.

But Li still had his work. When the Tiananmen Square tragedy slammed the door shut on his future in China, Li found another avenue to pursue his dream: the U.S. EPA's new Office of Global Change. And so it was that one of China's former top administrators found himself tackling the question of how to quantify greenhouse gas emissions from U.S. agriculture.

Li began with nitrous oxide, the least known of the three agricultural greenhouse gases, which include carbon dioxide and methane. For three years he worked to develop a model designed to quantify emissions from a gas with characteristics that make it exceedingly difficult to measure. His model took into account chemical, physical and biological processes.

"He was way out ahead in producing a model that was attempting to be very detailed and robust at local-scale measurements," says Robert Harriss, a former professor in UNH's Complex Systems Research Center at the Institute for the Study of Earth, Oceans and Space. "Most work being done at that time, and even still today, is all about global modeling, which sort of produces an average for the world. Whereas if one wants to make changes in the way people do farming or forestry, it will generally occur in a specific area. And that's what Changsheng realized—that these models had to come back to the human scale."

When Harriss invited Li to UNH in 1991 to give a talk about his model and work in China, it was obvious that Li and EOS were made for each other. "He had a grasp of the issues that was stunning," says Harriss. "It was clear to us that Changsheng's scientific skills and vast knowledge of China would enrich our environmental programs at UNH."

Li joined the UNH team as a research professor in 1992 and has spent the years since refining his biogeochemical Denitrification-Decomposition (DNDC) model, which is

used to describe the cycling of carbon and nitrogen and their effects on plant production, soil fertility and trace gas emissions in the ecosystem. "We make changes almost every month based on new research," says Li. "The improvement is endless."

Li's contribution, along with others, has placed UNH's EOS institute at the forefront of the field, according to Harriss, who is now director of the Environmental and Societal Impacts Group at the National Center for Atmospheric Research in Boulder, Colo. "It's particularly remarkable for a small public university to be in such a prominent position."

Berrien Moore, director of EOS, notes that Li's model has been used by more than 20 countries. It has been implemented in the farmlands of California, the pastures of the United Kingdom and the rain forests of Costa Rica. "Li's work on biogeo-

chemical modeling is making a major contribution to international efforts to improve national-scale assessments of greenhouse gas emissions," Moore says.

In a striking turn of events, Li's current work has taken him back to China, where he is using the model to study methane emissions from rice fields. "Methane has a much greater warming potential than carbon dioxide," says Li, explaining that methane is 21 times more potent than carbon dioxide, the more famous greenhouse gas. Since 1750, methane concentrations in the atmosphere more than doubled; in the last 20 years, the rate of increase has slowed. Li's recently-completed, NASA-funded study finds that changes in China's rice farming practices may have led to the decrease.

In the early 1980s, Chinese farmers began draining their fields midway through the growing season to increase yields and save water. Methane reduction was an unintended benefit. "But the reduction is highly variable from place to place," says Li. "It's very hard to draw a simple relationship between the management change and methane emissions because there are so many other factors."



Post-doctoral researcher Jianbo Cui, left, and research associate professor Steve Frolik '80, '86G process Chinese rice samples to analyze their nitrogen content.



Chinese farmers harvest rice plants in a paddy in Anhui Province on a summer day.

That's where the DNDC model comes in. If all the specific variables are provided, Li's model can predict, using different management scenarios, total methane emissions for all of China. For three years, Li and his colleagues collected data at the local level: weather, soil properties, crop types and rotations, tillage, fertilizer and manure use, water management and more. On research trips to China, they visited farms and laboratories. Li walked the fields, talking with farmers in his native Chinese and gathering soil samples from the land he could no longer call home.

Back at UNH, Li's model was used in conjunction with satellite data, which generated new maps of China's rice fields and quantified the total acreage of the country's fields. Researchers then ran the model, which takes into account 2,500 counties in China (two-thirds of which grow rice in a variety of crop rotations), two types of soil and two types of water management scenarios. The findings, based on more than 10,000 simulations, show a 40 percent decline in methane emissions from 1980 to 2000. "If rice farmers around the world change management practices, we can increase yields, save water and reduce methane as a greenhouse gas," Li says. "That's a win-win situation." Based on the success of the research in China, Li is beginning another study, extending his work to include the rest of Asia—millions and millions of rice-producing acres in 15 countries.

In the years ahead, Li will continue research in his homeland, though his visits remain tense. "They are always keeping an eye on my activities over there," says Li. He and his family are American citizens now, so he feels relatively safe. But the impact politics has had on his career and on his life remain indelible, a fact Li seems to regard with quiet acceptance and notable lack of bitterness. "I am not surprised by the political

tension," Li says.

Steve Froelking '80, '83G, a research associate professor of Earth science in the Complex Systems Research Center who works closely with Li, wonders whether most people would have the stamina to forge ahead with their research in the face of such setbacks. "He has this incredible capacity to focus," says Froelking, who like others, admires Li for more than his academic accomplishments. "He is extremely humble and always

"I think he's one of the most noble people I know."

has time for everybody. I think he's one of the most noble people I know."

Changsheng Li, the little boy who once trudged to school in a remote corner of China, now travels the world tracking chemical elements and seeking answers. Forced from his homeland, Li has forged a new and wider sense of community, cultivating cross-cultural relationships with researchers around the globe. He has built his career on the belief that lasting solutions can be found only as we acknowledge our common citizenship and our shared homeland—the beautiful and fragile planet Earth.

Suki Casanave's work has appeared in magazines such as Yankee, Smithsonian, Boston Magazine, Old Farmer's Almanac and Ladies' Home Journal. She earned a master's in English from UNH in 1986.