

A long journey to home

GABOR SOMORJAI LEFT BUDAPEST TO DISCOVER A NEW LIFE AND A NEW SCIENCE

Relaxing in his office, Gabor Somorjai pauses for a moment to reflect on his 43-year career at Berkeley. “A profession is a vehicle,” says Somorjai, “to achieve what you want from life. People choose a profession for three reasons — power, security or independence. Power? I wasn’t interested in that. Security? I never had any. Independence was my driving force.”



JUDITH AND GABOR SOMORJAI

Judith and Gabor Somorjai on their wedding day in Berkeley, Sept. 2, 1957. Chemical engineering professor **Charles Tobias** was their best man.

It was Somorjai’s fierce pursuit of independence that led him to flee Budapest after the Hungarian uprising against Soviet rule in 1956, to come to the United States to continue his education, and to turn down a lucrative promotion at IBM to return to academia to pursue his research.

“Success never came easy for me,” says Somorjai. “But if you let hardship get the better of you, then you are out.” Born in Budapest in 1935, Somorjai grew up with soldiers in the streets—first Nazis, and later Soviets. He doesn’t waste time comparing the two groups. “They were both bad,” he says.

His father was a businessman, and under the Soviets, he was labeled a “class enemy.” This status at first prevented the young Somorjai from entering a university, but he played basketball and water polo, and his athletic talents earned him an exception. His father encouraged him to study chemical engineering, because he thought that his son could find employment anywhere in the world as a chemical engineer.

Somorjai started at the Technical University of Budapest as a chemical engineering student in 1953. “It was the height of the Stalinist terror. People were disappearing left and right,” he says. In the fall of 1956,

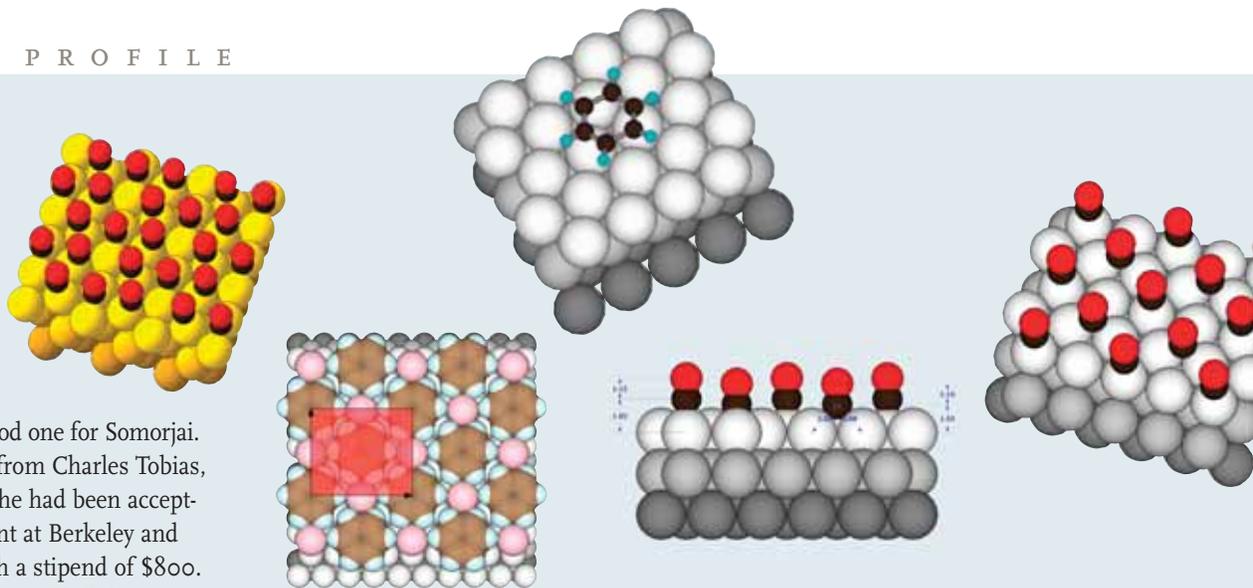
in his senior year, the Hungarian uprising began. Somorjai and his fellow students at the university were active in the revolution.

But the Soviet tanks rolled into Budapest on November 4, and the crackdown began. “When the Russians began arresting people, I decided to leave the country. I was four months from getting my diploma. I hid my machine gun in my organic lab locker and headed for the border.” He took with him two companions, his sister Marietta, and, after consulting with her parents, his girlfriend (and later wife), Judith Kaldor. He was 21, she was 18.

Somorjai was part of a mid-20th century Hungarian diaspora that included the scientists Leo Szilard, Edward Teller and Eugene Wigner, along with game theorist and computer pioneer John von Neuman, photographers Robert Capa and Andre Kertesz, financier George Soros, Intel co-founder and College of Chemistry alumnus **Andrew Grove**, and Berkeley chemical engineering professor **Charles Tobias**. It was Tobias who helped bring Somorjai to Berkeley as a graduate student.

“After the revolution was defeated, the engineers kept the trains moving to the west for the refugees,” Somorjai recalls. “But with soldiers guarding the final crossing, we had to leave the train 50 kilometers from the border. The local people hid us during the day, and we walked for four nights to the border, where guides led us to an area where we could cross safely. I remember it was late November 1956, cold and swampy.”

One of Somorjai’s first recollections of the west was an Austrian Red Cross safe house, where the refugees were given food and hot drinks. Then it was on to Vienna, where he encountered fellow Hungarian émigré Cornelius Tobias, brother of Charles Tobias. Somorjai traveled to the United States with Judith, where they had been sponsored by refugee agencies. Their first home in the U.S. was Camp Kilmer, NJ.



The year 1957 was a good one for Somorjai. It started with a letter from Charles Tobias, letting him know that he had been accepted as a graduate student at Berkeley and had been provided with a stipend of \$800. Tobias's letter starts, "First of all, let me greet you warmly on the occasion of your arrival to this blessed country. I hope that you will be as little disappointed in your expectations as I am after 10 years of life here. Now let's get down to business." Other letters followed to formalize the arrangement from College of Chemistry dean **Kenneth Pitzer** and the Berkeley registrar.

Somorjai's favorite class as a grad student was thermodynamics with **Leo Brewer**. "Brewer was an outstanding teacher with a deep knowledge of chemistry," says Somorjai. "He made the subject come alive." Even then Somorjai was fascinated by heterogeneous catalysis and polymers. But no one in the Department of Chemistry was working in these areas. Finally **Richard Powell**, a professor of inorganic chemistry, offered him a research job involving catalysis.

Somorjai completed his dissertation, entitled "Small Angle X-Ray Study of Metallized Catalysts," with Powell in 1960 and joined the research staff at IBM in Yorktown Heights, NY. In 1962, while he was working for IBM, he became a U.S. citizen.

It was at IBM that Somorjai's independent streak reasserted itself. Says Somorjai, "IBM wanted me to manage a new project, but I wanted to continue to study surface chemistry." In 1964, he decided to quit IBM and return to Berkeley as a professor, even though it meant a 50 percent salary cut.

Somorjai returned to Berkeley just as the Free Speech Movement began, and as he put it, "All hell broke loose." Powell, his dissertation advisor, was the chair of the chemistry

department (and from 1968–70 the head of the Berkeley Academic Senate), "and he, along with chemistry faculty members **George Pimentel** and **Robert Connick**, helped keep the education process undamaged on the Berkeley campus," says Somorjai. Connick later served as the Vice Chancellor, Academic Affairs (1965-67) and as Vice Chancellor (1969-71).

It was at Berkeley in 1965 that Somorjai began his path-breaking work on the chemistry of surfaces. The development of low energy electron diffraction in the 1950s and 1960s allowed researchers to study surfaces at the molecular level. Somorjai and his research group began developing vacuum systems for examining the surface properties of model catalytic materials such as platinum single crystals.

Somorjai realized that the chemical properties of a surface depend upon the nature of the surface itself as much as they do on the bulk properties of the material. At the atomic level, surfaces have varied structures, and these structures induce varied chemistry. The planet Earth has large flat surfaces such as salt flats, but it also has mountains and ridges. The same is true for metal surfaces. "A smooth surface may be chemically inert," says Somorjai, "but atoms on the surface usually restructure and move to new locations because they have fewer neighbors than atoms in the bulk and therefore are bound differently. The surface can also have steps, and kinks in the steps, and that is where the chemistry appears. If you add defects to a smooth surface, then it can

break bonds. This concept became the fingerprint of my chemistry."

Somorjai's approach was to work with simple metal surfaces and discover how chemical reactions occur on them. He focused on platinum metal surfaces, since platinum has historically been the most important catalyst. Somorjai then moved on to more complex surfaces and nanoparticles of different shapes and sizes, similar to those used in industrial reactions. These methods have led to more efficient and more selective catalysts and have been the key driving force in the application of surfaces for advancement of microelectronics and hard disk drives, better understanding of lubrication and corrosion, and improvements in the interfaces between medical implants and the human body.

More recently Somorjai's group developed scanning tunneling microscopy methods, and working with Berkeley physics professor Ron Shen, they have developed sum frequency generation surface vibration spectroscopy to study surface reactions under real conditions without the need for placing the surface in a vacuum chamber.

In addition to his colleagues and students, Somorjai credits his success, and the success of the College of Chemistry in general, to an often-overlooked asset—its machine and electronics shops. "If you look at the work of College of Chemistry Nobel laureates such as **Melvin Calvin**, **Glenn Seaborg** and **Y. T. Lee**, their success was based on advances in instrumentation, and we owe that to our shops," says Somorjai.

The diagrams to the left show the varying ways molecules align themselves on the surfaces of catalysts at the atomic level.

Below Somorjai and graduate student Russ Renzas discuss the details of a spectroscopy experiment in Somorjai's lab at LBNL.



Somorjai was named University Professor by the UC Board of Regents in 2002, the highest honor bestowed on a faculty member within the UC system. He is also a Faculty Senior Scientist in the Materials Science Division and Director of the Surface Science and Catalysis Program at the Lawrence Berkeley National Laboratory.

Somorjai has won every major award that can be bestowed on a physical chemist by the American Chemical Society. In 2002, he received the National Medal of Science, the nation's highest award for lifetime scientific achievement. Earlier this year he was awarded the Priestley Medal from the American Chemical Society, the most prestigious honor bestowed on an American chemist. He also won the Wolf Foundation Prize in Chemistry. He was elected to the National Academy of Sciences in 1979 and the American Academy of Arts and Sciences in 1983. He has seven honorary doctorate degrees from universities around the world.

Somorjai has educated more than 120 Ph.D. students and almost 200 postdoctoral fellows, about 100 of whom hold faculty posi-

tions. Many more are leaders in industry. He is the author of three textbooks and over 1,000 scientific papers in the fields of surface chemistry, heterogeneous catalysis, and solid state chemistry.

"Professor Somorjai could be considered the father of modern surface chemistry and to have almost single-handedly set the molecular foundations of heterogeneous catalysis," says Francisco Zaera, a chemistry professor at UC Riverside who conducted his doctoral research with Somorjai in the early 1980s.

But Somorjai is not ready to rest on his laurels. Says Somorjai, "I often ask potential assistant professors the following questions: 'If you succeed, will you increase knowledge by an order of magnitude? If you had the best students and endless money, what would you do?' Many people cannot answer these questions."

Somorjai would study biological surfaces, especially the brain. "The human brain is a surface, and it is folded to increase surface area without increasing head size," he says. "Evolution loves surfaces. The skin is

a surface, and bones are porous surfaces, just like the zeolite catalysts used in the petrochemical industry. Enzymes are nanoparticle catalysts, at a scale where surface effects dominate."

Somorjai foresees that fighting global warming will require profound changes in chemistry and catalysis. He says that oil supplies are dwindling, and natural gas won't last much longer. Coal is dirty, and cleaning it up will be a major challenge. Solar power has tremendous potential, but solar energy is often produced far from where it is needed.

"We need ways to convert energy from one form to another," says Somorjai, "and to store excess energy in chemical bonds. We will have to use energy as cleanly and efficiently as possible. In a world of carbon dioxide neutrality, we will need to rethink all of our chemical processes."

That process of rethinking will be easier, thanks to Somorjai's decades of research. "I wanted to do something important," he says. "I put my stamp on the profession, and the profession allowed me to do everything I wanted to do in life."

Somorjai recently celebrated his 50th wedding anniversary with Judith, the 18-year-old girl who walked out of Hungary with him on a cold November day in 1956. She finished her undergraduate degree at Vassar in New York and in 1975 earned her M.S. in computer science at Berkeley. They raised two children, and photos of his four grandchildren grace his office bookshelf. They all live in the San Francisco Bay Area, as does Somorjai's sister Marietta, who eventually came to the U.S. from Vienna and raised her family here. Says Somorjai, "Judith and I were married in the fall of 1957. I was a first-year graduate student, and for our honeymoon we took a bus to Lake Tahoe over the Labor Day weekend."

Somorjai has returned to Europe many times, including to his native Hungary. "But for my family and me," he says, "the Bay Area is home. I look back now and see all the things I was able to do because I took the chance and came to Berkeley."