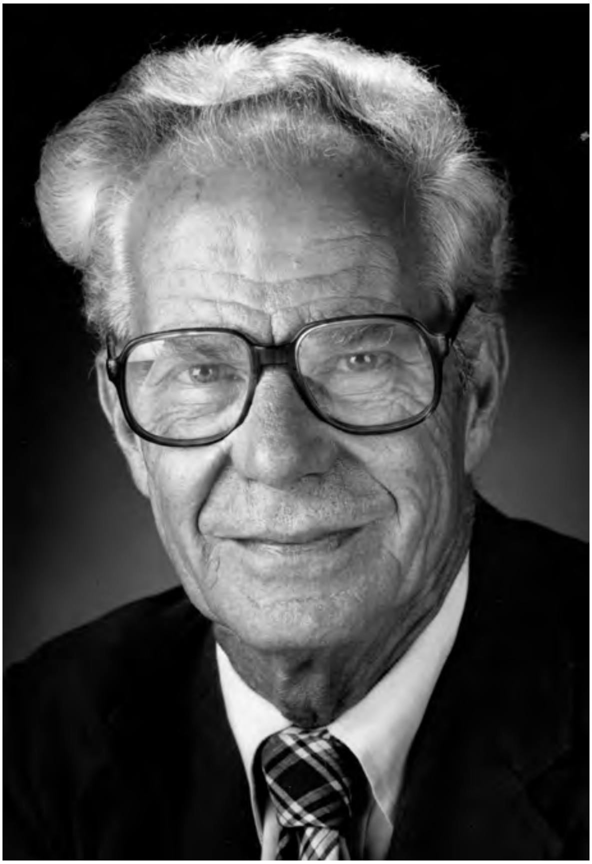

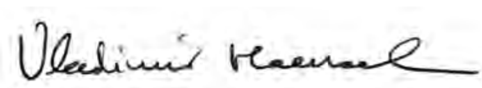

VLADIMIR HAENSEL

1914–2002

Elected in 1974

"Contributions to the development of processes for oil refining, including platforming, used to produce high-octane gasoline without lead."

BY STANLEY GEMBICKI
INTRODUCTION BY MARY GOOD

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The following biography of Vladimir Haensel (written by Dr. Stanley Gembicki, then director of research for UOP) is an excellent overview of Dr. Haensel's life and a great accounting of his seminal invention of the platforming process for the production of high-quality gasoline and aromatics. However, it does not capture the quality and uniqueness of the human we all called "Val."

I first met Val in 1979/1980 when he was retired from UOP Inc. but still quite active with the company as a consultant. One of his assignments for the company was to help them find a new vice president and director of research. He was then a professor at the University of Massachusetts at Amherst and a consultant to the petroleum refining industry. I was on the faculty at Louisiana State University in Baton Rouge and Val came to Baton Rouge to consult with the Exxon refinery and to talk to me about the research position at UOP. His enthusiasm for UOP and its mission was contagious. His description of the importance of fundamental chemistry tied directly to engineering practice was a challenging revelation to me. I was intrigued by the UOP culture and by what seemed a unique approach to rapid commercial exploitation of research results.

I did interview at UOP, was hired as VP for research, and spent several challenging and enjoyable years there. I continued to interact with Val during my tenure at UOP and he was my personal advisor on many issues at the UOP laboratory. During that time I came to realize how unique Val was, both in his scholarship and in his interaction with his colleagues. He could speculate on the details of catalytic reactions and then describe the engineering that would be necessary to both test his chemical theories and provide pilot plant testing to prove (or disprove) their utility in process design. His insight was holistic in ways that we rarely see but he was always sharing them with colleagues, especially young researchers. His influence was phenomenal. Personally he knew everyone in the laboratory and relished the opportunity to visit with them and challenge them to discover new insights for themselves.

Val was always upbeat and optimistic, even after the many tragedies in his own life beginning with his early years as a refugee and the tragic deaths of his first wife and one of his daughters. He was devoted to his other daughter, his son-in-law, his grandchildren, and his second wife, Hertha.

I have always felt a rare privilege having known Vladimir Haensel and being able to interact with him over many years. He was a unique human being who provided support and guidance to many people. His technology contributions through the platforming process were phenomenal, probably one of the most important environmental discoveries of all time. That process removed tetraethyl lead from gasoline, providing high-octane fuel (which allowed for high-performance, high-compression engines) and a source of aromatics for the plastics industry (which eliminated the need for coal tar chemistry). Such people are to be admired and remembered and, when possible, emulated.

VLADIMIR ("VAL") HAENSEL WAS born to Nina Von Tugenhold and Paul Haensel (Pavel Petrovich Genzel) on September 1, 1914 (one month after the outbreak of World War I) in Freiburg, Germany. He spent much of his youth in Moscow, where his father was a respected professor of economics from 1903 to 1928. Shocked by the outbreak of the Bolshevik Revolution, his family fled Moscow, but was captured and returned to meet an uncertain fate. Officially rehabilitated, his father resumed his professorship and was made director of the financial section of the Institute of Economic Research in Moscow from 1921 to 1928; there he authored Lenin's first five-year plan. After escaping the USSR in 1928, the Haensel family lived briefly in Germany, France, and Austria. They came to the United States in 1930 when Haensel's father accepted a teaching position at Northwestern University.

Haensel entered Northwestern University in 1931 and received a bachelor of science degree in general engineering in 1935. He received his master's degree in chemical engineering from the Massachusetts Institute of Technology in 1937.

Haensel joined the Universal Oil Products Company in 1937 as a research chemist. From 1939 to 1946, while still working for the company, he was assigned to the Ipatieff High Pressure Laboratory at Northwestern University as an assistant to the famous catalysis researcher Prof. V.N. Ipatieff (NAS, 1939), who was affiliated with both Northwestern University and UOP. (Some years earlier Ipatieff had defected from Russia, where he had been a general in the Imperial Army and a professor of chemistry at St. Petersburg University. Haensel told how Ipatieff's catalysis research grew out of his having been an artillery officer in the Imperial Army, intrigued with the high-pressure, high-temperature combustion chemistry occurring in cannons.) While at the laboratory, Haensel continued his education and earned his PhD in chemistry from Northwestern University in 1941. In the same year he was assigned as the coordinator of the "cracking" research division of UOP. During this time, his work focused on the use of catalysts other than platinum in the general reactions. Among his early successes was the development of a catalytic method of selective demethylation to make triptane, the hydrocarbon with the greatest antiknock properties of any compound. In 1951 he was appointed the director of refining research and in 1960 became the director of process research. In 1969 he became vice president and director of research, and in 1972 he was appointed vice president for science and technology, a position he held until 1979.

In the early 1950s it was established that the deadly photochemical smog frequently experienced in locales such as the Los Angeles basin was produced when nitrogen oxides and unburned or partially burned fuel hydrocarbons in auto exhaust reacted in bright sunlight. Haensel, at United Oil Products from 1956 to 1974, played a key role in establishing research and development programs that eventually culminated in the automotive catalytic converters that were first used on almost all US autos in the 1975 model year, and today are virtually ubiquitous in most of the developed and developing nations on the five nonpolar continents.

After 1979 Haensel was a consultant at UOP and a professor of chemical engineering at the University of Massachusetts, Amherst. He was a member of the National Academy of Sciences and the National Academy of Engineering and was recognized with awards that included the National Medal of Science, the Perkin Medal, the first National Academy of Sciences Award for Chemistry in Service to Society, the Professional Progress Award (American Institute of Chemical Engineers), the Draper Prize, and the Chancellor's Outstanding Teacher Award (University of Massachusetts).

Haensel was a multifaceted person, deeply interested in the world around him and the process by which it advanced. He was a patron of the arts, enjoying plays and music, particularly in the company of friends. His interest even extended to the writing of short stories, usually illustrating a lesson he had derived from his experience and study of the reactions of people to advancing knowledge. Perhaps best known of these is his whimsical *Lucky Alva* short story in which he brought forth his view of important lessons from the life of America's most famous inventor and entrepreneur (1967).

During the later years of his career in industry and his tenure at the University of Massachusetts, he felt an obligation to use his life experience to foster and mold the careers of young scientists. It was a joy for him to see young scientists develop into accomplished researchers who would make a real difference in the world. In his obituary he was quoted from a 1995 interview: "Work to produce something important. Do something new. Do something interesting, something that makes you want to shout out loud when you've got it. Life is too darn amazing—and too short—for anything less."

Of him it can be said: He lived life to the fullest and left his mark as a researcher and as a person. We are all the better for having known him and for having benefited from his work.

Development of the Platforming™ Process

Haensel's most important invention is without doubt the Platforming process. By 1940 the octane number of gasoline could be improved by the Houdry process, using clay catalysts, or by adding octane boosters. One octane booster was iso-octane, prepared by the Pines-Ipatieff process using strong liquid acids as the catalyst to alkylate olefins with branched paraffins. Another octane booster was tetraethyl lead, which was used heavily until the 1970s, when it was phased out of gasoline because of the toxicity of the lead compounds in auto exhaust. It was not generally understood that the clay catalysts used by Eugène Houdry were in reality solid acids and that the chemistry of catalytic isomerization and catalytic cracking of straight hydrocarbons was thus akin to that of the liquid-acid catalyzed alkylation invented by Ipatieff and Pines.

In 1947 Haensel began exploring the possibility of using platinum catalysts for upgrading petroleum. When he started working on what came to be called the Platforming process, there was no economically practical way to upgrade gasoline to high-octane numbers by reforming processes. Thousands of catalysts had been tried, but none was able to generate the necessary results. The existing 65-octane fuel was inefficient and caused knocking in the compression cycle of engines. Consequently, it prevented the development of high-compression engines and their promise of higher efficiency. In looking for a better way Haensel took a different approach and proposed something that at the time was considered both impractical and uneconomical.

He suggested the use of the precious metal platinum in the refining process, supported on alumina as a bifunctional catalyst. The marvelous catalytic properties of platinum had been described by J.W. Doebereiner and Humphry Davy around the year 1800. Doebereiner had even experimented with platinum supported on clay. Haensel thought that the miracle catalyst platinum might also be good for upgrading gasoline.

To most of his contemporaries this sounded crazy. Gasoline costs were between 8¢ and 10¢ per gallon, and platinum had never been considered a viable catalyst because it was too expensive—more expensive than gold—and could only be obtained in significant quantities in Russia and South Africa. However, Haensel understood that a catalyst that had a long life and could be regenerated and reused in situ would, in fact, be more economically efficient in the long run than a "cheap" catalyst with a short life. After his initial tests confirmed the high stability and good activity of platinum on alumina, he tried to minimize the amount of platinum. He knew that only surface atoms are used in heterogeneous catalysis, so he directed his efforts to prepare extremely high dispersed supported platinum. In 1947 he showed that a catalyst with 0.01 percent platinum on alumina was both active and stable. Clearly, the platinum particles of this catalyst must be extremely small. Hydrogen adsorption indicates that more than 50 percent of the platinum atoms are surface atoms.

Even more important was his proposal that platinum on alumina was a dual-functional catalyst, ideally suited to the catalytic reforming chemistry. Platinum is an excellent hydrogenation and dehydrogenation catalyst, but acid-base chemistry is required to go from saturated alkane chains to aromatic rings. That was evident from the work of Houdry, Ipatieff, and Pines. Haensel's insight was not only that alumina, a Lewis acid, could physically support dispersed platinum but also that the unsaturated hydrocarbons formed by the platinum could be isomerized to rings on the acidic alumina. He established this key synergism by testing both the supported catalyst and physical mixtures of platinum and alumina, where the contact with intermediates was not intimate.

Another major advantage of Haensel's process was that it generated large amounts of hydrogen. In addition to the economic value of the hydrogen, its production helped to remove much of the sulfur and other contaminants found in petroleum. Hydrogen generation, therefore, is an important step in making the Platforming process a much more environmentally friendly process than any previous refining technique. Gasoline produced by the Platforming process also has a higher octane value than gasoline produced using older methods. Higher-octane fuels burn much more cleanly and efficiently, reduce knocking, and improve mileage and engine performance.

In addition to cleaner, cheaper fuel this process generated a higher yield of aromatic hydrocarbons—the raw materials used in the manufacture of plastics. This created the base for the modern plastics industry, which previously relied on the processing of coal tar, a very environmentally unfriendly process. Through catalytic reforming chemistry, more than 200 billion pounds of aromatic hydrocarbons are produced each year.

It could be concluded that Haensel was the inventor of catalysis with supported nanoparticles of platinum, although that word was coined much later. It is now one of the buzzwords in materials science; few people realize that in heterogeneous catalysis, nanoparticles have routinely been used for six decades thanks to the work of Vladimir Haensel.

The Achievement's Worldwide Impacts

Each of us benefits daily from the fruits of Vladimir Haensel's work. The engineering breakthrough of the Platforming process has helped shape our economy in many ways, from the inexpensive processing of high-grade fuels to the production of plastics in a more environmentally sound way. These advances have directly and indirectly contributed to many of the world's industries. We can easily take for granted the abundance of low-cost, high-efficiency fuels without realizing that the ability to economically transport food, medicine, industrial supplies, and even our mail is very much dependent on Haensel's invention.

Indeed, the Platforming process has reduced the United States' reliance on foreign oil, has broadened the long-term energy outlook for the world, and has saved billions of dollars in transportation costs. The United States has over 190 million cars, trucks, and buses that consumed nearly 132.9 billion gallons of gasoline each year. They serve the bulk of the nation's transportation needs, bring families together, and deliver food and medicine. A gallon of reformed high-octane gasoline produced through the Platforming process can provide 35 percent more mileage than previous methods as well as much higher performance. The savings in natural resources and costs to the consumer are tremendous.

At the time of this writing, the United States spends, on average, $123 billion per year to buy gasoline. The estimated cost of operating an automobile in the United States was about 46¢ per mile; of that, the cost of gasoline and oil was only 6¢. World consumption of oil was 66 million barrels per day, of which the United States accounts for roughly one-fourth.

Vladimir Haensel Returns to Teaching

After serving as vice president for science and technology at UOP, Haensel joined the faculty at the University of Massachusetts, Amherst, in 1980 as professor of chemical engineering. He continued to teach at the university and also served as a consultant to UOP until his passing.

Known across campus as "Val," he was an influential figure at UMass Amherst, both as a teacher and as an advisor to students, faculty, deans, and chancellors. He took particular pride in two elective courses he taught to mixtures of undergraduate and graduate students: Catalysis and Energy Conversion Processes, and Industrial Chemistry. His style was Socratic, often aided and abetted by his wife, Hertha Skala Haensel, former director of physical chemistry and surface science at

UOP. Following preparative study, the students launched into spirited discussion, punctuated by anecdotes, stories, and occasional apples from the teacher in recognition of new insights.

He also cherished the chance to work with undergraduate and graduate students in the lab, exploring new science with them and sharing his experience and research philosophy. The company contributed directly to this activity by creating a Vladimir Haensel/UOP research scholarship fund, which sponsors research by undergraduates.

Haensel served as a board member of the Petroleum Research Fund, 1979–1982; chair of the US-USSR Technology Exchange in Chemical Catalysis, 1976–1979; US State Department Representative to the International Scientific Forum in Hamburg, Germany, 1980; chair of the advisory committee, Industrial Science and Technology Innovation of the National Science Foundation, 1982–1985; and a member of the board of directors of Heico Corporation.

He authored more than 120 scientific and technical papers, and was granted over 145 US patents and 450 foreign patents. He was elected to the National Academy of Sciences in 1971 and the National Academy of Engineering in 1974. Among his many awards and honors was the National Medal of Science from President Nixon on October 10, 1973. He was also the first recipient of the National Academy of Sciences' Award for Chemistry in Service to Society in 1991. In 1994 he was awarded the Chancellor's Outstanding Teacher Award from the University of Massachusetts, Amherst. In 1997 he was selected by the National Academy of Engineering to receive the Charles Stark Draper Prize.

Haensel is survived by his wife, Hertha Skala Haensel, who lives in Amherst. His daughter, Kathee Webster, lives in Virginia Beach, Virginia. Before his passing, Haensel was investigating the use of hydrogen as a fuel.

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