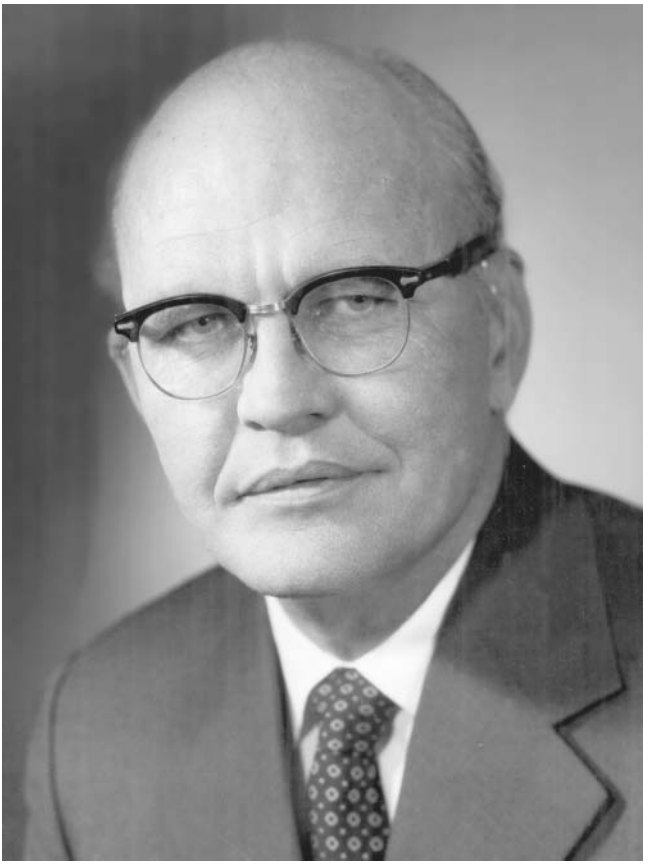

JACK ST. CLAIR KILBY

1923–2005

Elected in 1967

"For inventions basic to integrated circuits."

BY TOM ENGIBOUS

JACK ST. CLAIR KILBY, inventor of the integrated circuit and pioneer in the semiconductor industry, died of cancer on June 20, 2005, at his home in Dallas at the age of 81. First and foremost an engineer, he took satisfaction and pleasure in finding practical solutions to vexing problems.

Jack was born on November 8, 1923, in Jefferson City, Missouri, to Hubert and Vina Freitag Kilby. When he was still young, the family moved to Great Bend, Kansas, where he and his sister, Jane, were reared. He considered Great Bend his hometown.

His father was president of a small power company with customers scattered across rural western Kansas. In 1937, a severe ice storm hit the region, downing telephone and power lines. Although he was just a teenager at the time, Jack accompanied his father as he worked with amateur radio operators to communicate with isolated customers. That experience triggered Jack's lifelong interest in electronics. Following the storm, he got his own radio license, built a transmitter, learned all he could from older ham radio operators, and began to operate radios himself. These events influenced his decision to study electrical engineering.

Jack applied to MIT but narrowly missed passing the math portion of his entrance exam. Instead, in 1941, he ended up at his father's alma mater, the University of Illinois. Like many in his generation, his education was interrupted by World War II.

Jack joined the U.S. Army where, after taking radio operator training, he was transferred to the Office of Strategic Services. He spent the war as a radio operator and repairman in the India-China-Burma theatre.

After the war, he returned to the university to resume his studies and received his bachelor's degree in electrical engineering in 1947. During this period, he also met his wife, Barbara Annegers Kilby. They were married on June 27, 1947, and were together for 34 years until she died in 1981.

After graduation, Jack went to work for the Centralab Division of Globe-Union Inc. (now part of Johnson Controls) in Milwaukee, where he designed and developed ceramic-base silk-screen circuits for consumer electronics products. In spring 1952, he was Centralab's representative at an eight-day symposium hosted by Bell Labs, where he learned about Western Electric's new technology, transistors. Jack remained at Centralab for 11 years, immersing himself in the nascent field of semiconductors. During this time, he also earned a master's degree in electrical engineering from the University of Wisconsin.

In May 1958, Jack moved to Dallas to work for Texas Instruments (TI) in the general area of microminiaturization—a key issue facing the young semiconductor industry. At the time, semiconductors required hand soldering of thousands of discrete components, which was a gating factor in the development of more elaborate, reliable, cost-effective electronic circuits. TI, and the industry as a whole, was struggling to resolve the dilemma posed by this "tyranny of numbers."

TI made resistors, capacitors, transistors, and diodes, and Jack's first solution was repackaging. But a detailed cost analysis showed that this would be impractical, because the overhead at a semiconductor house like TI was two to three times what it was at Centralab. Fearing he would be assigned to work on a proposal for the micro-module program, a miniaturization initiative sponsored by the U.S. Army Signal Corps that Jack didn't believe would work, he threw himself into finding a viable alternative quickly. Coincidentally, TI was readying itself for the mass vacation that was customary for employees at the time. As a new employee, Jack didn't have any vacation time stored up, so he

had some relatively quiet time on the TI campus to ponder the issue.

Ever the practical engineer, Jack came to the conclusion that the only thing a semiconductor firm could make cost effectively was a semiconductor. Then, in the course of a day, he came to the conclusion that resistors and capacitors could be made from the same material as the active devices, and that they could be made in situ, that is, interconnected to form a complete circuit. This was a simple, elegant solution to a problem that had stymied the best and brightest minds for several years.

When his supervisor returned from vacation, Jack showed him his sketches and was challenged to prove that circuits made entirely of semiconductors would work. Jack did so and then set out to build an integrated structure as he had originally planned. On September 12, 1958, he put the monolithic integrated circuit to the test—and it worked! He had conceived and built the first integrated circuit. Little did he know that his invention would change the world.

Jack's achievement was publicly announced in March 1959, but, like many breakthrough technologies, it wasn't widely accepted at first. The industry was still wedded to transistor technology, design, and manufacturing, and so did not initially embrace the integrated circuit.

However, the U.S. Air Force was very interested in a technology that could reduce the size and cost of its computers. In 1962, TI won its first major integrated circuit contract to design and build a family of 22 special circuits for the Minuteman missile. The success with the Minuteman slowly opened the doors to customer acceptance, and computer manufacturers began to adopt integrated circuits as well.

Still, the chip had yet to cross over to consumer applications. Hoping to jump-start the market, TI management challenged Jack to design a calculator powerful enough to perform the math functions of the large, electromechanical desktop models of the day but small enough to fit in a coat pocket. Jack led a team comprised of Jerry Merryman, Jim Van Tassel, and himself that successfully delivered a working model by December 1966.

Jack went on to pioneer military, industrial, and commercial

applications of his invention, manage projects, and pursue concepts for new generations of integrated circuits. He was instrumental in the continuing development of integrated circuit technology during those years, as he worked "hands on" on various aspects of design, packaging, and process technology tools.

In 1970, he took a leave of absence from TI to become an independent consultant, focusing his energies on integrated circuits, primarily in consumer-related applications. He explored, among other subjects, the use of silicon technology for generating electrical power from sunlight. From 1978 to 1984, he served as Distinguished Professor of Electrical Engineering at Texas A&M University. He officially retired from TI in 1983 but continued to do consulting work with the company and maintained a significant relationship with TI until his death. In later years, Jack was director of a few corporate boards and a member of advisory committees for selected organizations.

Jack's work laid the foundation for the field of modern microelectronics and moved the industry toward the miniaturization and integration that continues today. As a pioneer in the industry, he received innumerable honors and awards recognizing his contributions to the field and their impact on the world at large.

Jack was awarded the Nobel Prize in Physics (2000) for his role in the invention of the integrated circuit. He was one of only 13 Americans to receive both the National Medal of Science and the National Medal of Technology, the highest technical awards given by the U.S. government. He was awarded the Kyoto Prize in Advanced Technology, Japan's highest private award for lifetime achievement. He was also the recipient of the first international Charles Stark Draper Prize, the world's top engineering award, from the National Academy of Engineering.

Jack was elected a member of the National Academy of Engineering in 1967, was an IEEE Fellow, and held more than 60 patents for a variety of electronics inventions. In addition to the integrated circuit, these included the handheld electronic calculator and the thermal printer, both of which he co-invented.

Jack received honorary degrees from several institutions of higher learning, including the University of Miami, Rochester Institute of Technology, University of Illinois, Southern Methodist University, Texas A&M University, and Georgia Institute of Technology.

Any biography of Jack would be incomplete without describing the quality of the man. Jack was a unique and special individual. Quiet and thoughtful with a generous spirit, he took the time to encourage young engineers and frequently allowed grade-school students to interview him for class papers. He was a man of few words, yet his well-thought-out comments were often peppered with quiet humor. Jack was quick to credit the thousands of engineers who followed him for growing the semiconductor industry. Quoting an earlier Nobel Prize winner in the introductory remarks of his Nobel Lecture, Jack compared his feelings about the tremendous strides the industry had made with those of a beaver looking at Hoover Dam—"It's based on an idea of mine."

Jack was a gentle man and a gentleman, and at 6 feet 6 inches, he was occasionally called a "gentle giant" by the media. Low-key and practical, Jack was a man who had earned the right to boast but never did. Above all, he was an engineer who enjoyed both the craft and art of his profession. Jack shaped an industry, but even more, he touched our souls. He will be remembered both for what he accomplished and for who he was.

It would be an incomplete portrait of Jack not to mention how important his family was to him. He is survived by two daughters, Janet Kilby Cameron and Ann Kilby; five granddaughters, Caitlan, Marcy, and Gwen Cameron, and Erica and Katrina Venhuizen; and a son-in-law, Thomas Cameron. His wife, Barbara, and sister, Jane, preceded him in death.