BARRIE GILBERT died at the age of 82 on January 30, 2020, in Portland, Oregon. He was a leader in the evolution of electronic circuits based on transistors.

He was born June 5, 1937, to Fredrick Arthur and Edith (Tansley) Gilbert in Bournemouth, Dorset, England. His father died in a bombing attack when Barrie was 3 years old.

By age 9 he had started experimenting with electronic circuits. At 17 he got his first job in electronics and later studied physics at Bournemouth College, after which he worked on speech encryption systems at the UK government’s Signals Research and Development Establishment and on nuclear reactor control systems at the Atomic Energy Research Establishment.

Oscilloscopes held a special fascination for him. In 1959 he joined Mullard Ltd., a UK manufacturer of electronic components, where he developed almost all the key circuits for a transistorized sampling oscilloscope that could capture waveforms with GHz bandwidths. After seeing a Tektronix oscilloscope, he was inspired to design his own model, which led him in 1964 to a job at Tektronix in Beaverton, Oregon, working on the legendary 7000 series of oscilloscopes.

As an early user of the company’s in-house bipolar integrated circuit (IC) process, he was among the first to recognize
that, to actualize the unique potential of monolithic circuits, a new style of circuit design was needed. In the early 1970s he was a pioneer in exploring superintegration to shrink chip area, and thus cost, to realize novel functions that would set apart Tektronix oscilloscopes, such as an analog character generator that showed the knob settings on the display.

By 1972 he had already established a reputation as one of the industry’s most creative analog designers, with the invention of the famous Gilbert cell mixer and a trove of other patents. But that year he had taken a sabbatical from Tektronix to care for his ailing mother in a small town southwest of London. I tracked him down and convinced him to set up Analog Devices’ first remote design center in a room in his mother’s home. When he returned to America in 1977 he established a design center in Oregon and recruited and mentored a remarkable team of analog designers.

Barrie’s impact at Analog Devices was felt immediately as analog IC products began to replace discrete transistor designs in a wide range of applications. One after the other he turned out the industry’s first analog ICs in several product categories. Over nearly 50 years he designed an impressive array of innovative IC products whose lifetime revenues are estimated at $2 billion. Some of the seminal products designed in the 1970s remain best in class and continue to be shipped today. And as one of Analog’s first two corporate fellows he attracted talented engineers to the company and was an inspiring teacher and mentor in developing many world-class designers.

He also distinguished himself in writing about his groundbreaking research findings. In December 1968 he published two landmark papers in the IEEE Journal of Solid-State Circuits. The first, “A New Wide-Band Amplifier Technique,” described a new circuit topology for amplification across very wide bandwidths, with the unique property that it is linear to large signals with a gain that is set precisely by the ratio of two biasing currents; obviously this was motivated by the needs of the vertical amplifier in an oscilloscope, which receives input waveforms of very different levels and whose gain, therefore, is selected across a large range. The second article, “A Precise
Four-Quadrant Multiplier with Subnanosecond Response,” showed how there emerges from this circuit an accurate algebraic multiplier of two independent analog waveforms. Years later, Barrie would describe how both circuits descended from the current mirror, itself an iconic monolithic analog circuit concept.

At the time, analog computation was used extensively in real-time control systems in mission-critical applications such as aircraft and space vehicles. While the operational amplifier (op amp) had enabled most algebraic and calculus-based operations, multiplication remained elusive and many of the op amp–based solutions were inaccurate, irreproducible, and temperature dependent. The Gilbert multiplier changed all that.

In his paper Barrie brought forth and analyzed all obvious forms of residual inaccuracy arising from device and circuit imperfections in the computed product. To this day, the Gilbert four-quadrant multiplier circuit remains definitive.

An indefatigable enquirer, Barrie noticed that a certain principle was at work in these two circuits, pinpointed it in the debut publication in the clearest possible terms, and named it the translinear principle, which states that the products of the current densities clockwise in the loop balance those counterclockwise and, importantly, enables interesting, often unexpected uses.

It is a sign of Barrie’s brilliance that in short order he would discover a nearly exhaustive catalogue of useful circuit topologies based on the translinear principle. An exact multiplication of a waveform with itself using as few as three transistors suggested to him other integrated nonlinear functions, most usefully the real-time computation of the true root mean-square (RMS) value of arbitrary waveforms. The resulting RMS-DC converters, as he called them, displaced cumbersome earlier methods to realize the same functions and are just one example of his contributions to the “instrument on a chip” concept.

Other notable contributions include a very linear and stable voltage-frequency converter (1976), which provided cheap (for the time) analog-to-digital conversion at sensor interfaces,
transmitting a square wave into a counter. Variable gain amplifiers are used for automatic gain control in every communication system, but seldom recognized as a circuit form worthy of investigation in their own right. Barrie maintained an enduring interest in these circuits, and designed industry-leading logarithmic amplifiers based on new circuit principles. These ICs are now ubiquitous in wireless communication infrastructure and devices for the precise measurement of signal strength.

Barrie was acutely aware that a gulf exists between the exploration of a circuit idea and its development into a product. Often, he wrote, he would spend more time on design of the support and auxiliary circuits than on the functional core. He liked to design IC products end-to-end, worrying about matters such as the IC layout and the most user-friendly pin allocation on the package. He wrote data sheets for his products, their test plans when put into mass production, and extensive application notes that make for masterly tutorials.

He also advocated that in many instances, the marketing department or even the customer may not have envisaged uses for a product conceived by the circuit designer that, when introduced into the market, would open unforeseen applications.

His accomplishments were acknowledged in many ways. In addition to his election to the NAE as a foreign member, he won the ISSCC (International Solid-State Circuits Conference) Best Paper award five times, and the IEEE Solid-State Circuits Award (1986 and 1992), now known as the IEEE Donald O. Pederson Award in Solid-State Circuits. His office walls were lined with more than 100 patents. He retired from active product development at the age of 82.

Barrie was unconventional in every possible way. He never lived the same day twice but continuously built on his experience to reveal new insights and discoveries. There were no rule books, only fundamental principles and learning from experience. His vision and dedication to excellence in everything he undertook were an inspiration for all who had the privilege to know him. A man of many talents, he rearranged sonatas for
orchestra or wind ensemble on his synthesizers, wrote poetry, and had a collection of museum-class electronics.

He met his future wife, Alicia Moore, at an electronics conference in 1988 and they were married May 6, 1990. He is survived by Alicia; former wife Myrna; children David (Wanda) of Gaston, Timothy of Bend, Lynn (David) of Augusta, Montana, and Anne (David) of Eugene; three grandchildren; and one great-grandchild.