NATIONAL ACADEMY OF SCIENCES

JOHN R. WHINNERY
1916—2009

A Biographical Memoir by
THEODORE VAN DUZER, CHARLES K. BIRDSALL,
AND DAVID H. AUSTON

Biographical Memoir

Photo Credit: Ed Kirwan Graphic Arts, Berkeley, California.

JOHN R. WHINNERY

July 26, 1916–February 1, 2009

BY THEODORE VAN DUZER, CHARLES K. BIRDSALL, AND DAVID H. AUSTON

JOHN ROY WHINNERY, FORMER DEAN of engineering at the University of California, Berkeley, National Medal of Science recipient, and a distinguished innovator in the field of electromagnetism and communication electronics, died Sunday, February 1, 2009, at his home in Walnut Creek, California. He was elected to membership in the National Academy of Sciences in 1972 and was a member of its Section 31, Engineering Sciences.

Whinnery was born in Read, Colorado, on July 26, 1916, and moved with his family at the age of 10 to Modesto, California, where his father continued his farming and maintained an avid interest in electrical and mechanical systems. Whinnery's father had also bought and operated a light plant to generate electricity for a small town in Colorado, an event that may have influenced the younger Whinnery's development.

By the time Whinnery graduated from high school in 1933, the Great Depression had already begun, and his family struggled to obtain money for him to attend college. In the introduction to an oral history of Whinnery's life it was noted that he could only afford to attend a local junior college but that he greatly impressed his instructors there. Those instructors knew that he would flourish at Berkeley,

but funding remained beyond his reach. Unbeknown to Whinnery several of his teachers took up a collection and financed a scholarship to send him to UC Berkeley. After transferring to UC in 1935, Whinnery proved those instructors right, graduating in 1937 with a bachelor's degree in electrical engineering, and earning the University Medal, which is awarded to the top graduating senior; this is the campus's highest student honor.

Whinnery worked the next nine years at General Electric Company in Schenectady, New York. Possessing only a bachelor's degree and no prior experience in research, he rapidly acquired the respect of his coworkers and became a key contributor to GE's research programs in electron devices and electromagnetics. His earliest work focused on understanding discontinuities in electromagnetic wave devices and led to seminal work on the analysis of transmission lines and discontinuities in waveguides. The unique contribution that John Whinnery made was that he was able to calculate from first principles the equivalent circuit elements of different types of discontinuities and show how the geometry influenced the magnitude of the reflection and transmission coefficients. He also worked on microwave tubes, especially disk seal triodes ("lighthouse" tubes), which had important applications in the radar transmitters and receivers used in World War II.

The story about his analysis of waveguide discontinuities provides an interesting insight to John's early research career. When he presented a paper on his results at the Institute of Radio Engineers convention in New York in 1944, he was taken aback when Nathan Marcuvitz from the MIT Radiation Laboratory came up to him and, somewhat "put out," described to John the unpublished work that he and Julian Schwinger had done at the Rad Lab on the same topic. For security reasons the Rad Lab would not permit Marcuvitz

and Schwinger to publish their work, even though it was not classified. Although the two approaches were developed in parallel they were not entirely duplicative. To put this into context, one has to remember that John was a young engineer at the time with only a bachelor's degree and had largely taught himself the necessary analytic tools; yet he had scooped two of the foremost electromagnetic theorists in the world.

At GE he met Simon Ramo, who became a collaborator, mentor, and coauthor with John of the textbook *Fields and Waves in Modern Radio*. First published in 1944 and now in its third edition and still widely used, the book has become one of the most successful and widely deployed engineering textbooks. Subsequent editions enlarged the authorship (by adding Ted van Duzer) and expanded the scope of the book to include lasers and optics with the revised title of *Fields and Waves in Communication Electronics* (1994). Lucid in style yet rigorous in content *Fields and Waves* brought the study of electromagnetism to a larger audience and made it accessible to many generations of engineers and scientists. In 1994 friends and former students surprised Whinnery at a celebratory event honoring the book's 50th anniversary by endowing a faculty chair in his name.

After the war, Whinnery realized that in spite of his significant accomplishments at GE, he needed to advance his education beyond the bachelor's level. Therefore, in 1946 he returned to UC Berkeley, where he became a lecturer in electrical engineering and enrolled in the Ph.D. program. Upon earning his doctorate just two years later he was appointed an associate professor of electrical engineering.

In 1951 Simon Ramo, who had moved to California, persuaded Whinnery to take a leave from the university and join a new research group at Hughes Aircraft Company as head of the microwave tube section. In the one and one-half

years that he spent at Hughes he made important contributions to traveling wave tubes and backward wave oscillators. Although John immensely enjoyed the intellectual stimulation of his Hughes colleagues, such as Dean Watkins, Dick Johnson, Tony Siegman, and Ned Birdsall, in 1952 the lure of the university and his students pulled him back to Berkeley, where he became vice chair of the Division of Electrical Engineering and director of the newly formed Electronics Research Laboratory. He formed a graduate research group in microwave tubes that explored, through the ensuing decade, fundamental issues in microwave tubes, including backward-wave amplifiers and tubes employing crossed electric and magnetic fields. A principal focus of the research was causes of noise and means of its suppression.

As chair of the Division of Electrical Engineering from 1956 to 1959 Whinnery drove the postwar transformation of UC Berkeley's electrical engineering department from the handbook era into a modern science-based program. It was also during this period that the division became a full department, an important step that granted greater hiring and budgetary responsibility to the chair and faculty. As always his approach was thoughtful, strategic, and collegial. Acknowledging the established strengths in microwaves and electromagnetics, he and his colleagues chose three priorities for hiring: computers, solid-state electronics, and information theory. With a mandate from the dean to expand the department and hire at least seven new faculty members, John embarked on an aggressive and highly successful recruiting program.

Not surprisingly, Whinnery went well beyond the initial goal and greatly strengthened the department. Ernie Kuh and Charles Desoer were lured away from Bell Labs to strengthen the circuits and systems area. Tom Everhart (later to become president of Caltech) brought expertise

in electron microscopy. Lotfi Zadeh, who later invented the field of fuzzy logic, was persuaded to leave Columbia. Alan Lichtenberg and Alan Trivelpiece (later to become director of Oak Ridge National Laboratory) brought expertise in plasma physics and engineering. Shyh Wang and J. R. Singer came with expertise in solid-state devices and electronics.

The impact of these recruitments was enormous. Prior to the Second World War and in the period immediately following the war, electrical engineering at Berkeley was a sound but little-known department. However, by the mid 1960's the Department was regarded as among the best in the country. It was ranked third after MIT and Stanford in both the 1966 report by the American Council on Education, "An Assessment of Quality in Graduate Education," (known as the "Cartter" report in reference to its principal author, Allan M. Cartter), and in the 1970 peer survey by Kenneth Roose and Charles Anderson. This standing was sustained in the "Assessment of Research-Doctorate Programs in the United States," published in 1982 by the National Academy of Sciences in conjunction with the National Research Council which placed the UC Berkeley Electrical Engineering Department tied with Stanford and a close second to MIT. Although many people contributed to this success story John provided the key leadership. He not only hired the brightest possible people into strategically important emerging areas but also fostered a culture of excellence and cooperation that characterizes the department to this day.

Whinnery's success as chair led quite naturally to his appointment as dean in 1959. However, he had a strong desire to return to his teaching and research and was reluctant to make an open-ended commitment. Consequently he agreed to take on the job only if it were limited to three or four years of service. In spite of his ambiguous feelings about

university administration, John was fully committed to his responsibilities as dean, and the college thrived under his leadership and grew in strength and national stature. Using the same strategic approach that worked so well in his home department, Whinnery expanded the science base of the college and encouraged the departments to add strength in newly emerging directions, build their research base, and strengthen the curriculum.

Whinnery earned a national reputation in matters of engineering education and played a key role in the creation of the National Commission on Engineering Education, of which he served as chair during the late 1950s and early 1960s. The commission grew out of a concern by the National Science Foundation about the future of engineering education. Although heavily supported by NSF, it was a separately incorporated entity with a mission to recommend and develop innovative approaches to engineering education, such as computer-aided instruction, televised instruction, and outreach programs to high schools.

In the early 1960s Whinnery became interested in the emerging field of lasers and laser applications to communications. Always the student, he decided to return to industry to retool and learn firsthand about this exciting new field. Shortly after completing his tenure as dean in 1963, John accepted an invitation from Chape Cutler, a colleague at Bell Labs, to go on leave to the New Jersey laboratory for a year. He has often remarked that his experiences in industrial research labs were formative to his career, even more so than sabbaticals at other universities.

Working with Jim Gordon and others at Bell Labs, John developed and analyzed the phenomenon of thermal lensing, whereby laser beams are defocused due to minute changes in index of refraction caused by trace absorption. An extremely sensitive and usually undesirable effect, thermal lensing can

also be usefully applied to monitor and measure extremely dilute traces of solvents in liquids and other absorbing media. Prior to John's work there was considerable disagreement about the mechanism responsible for the defocusing of laser beams in materials. Some had suggested it might have a thermal origin, but the small absorptions that were present caused many to dismiss this explanation. John's detailed analysis demonstrated conclusively that the mechanism responsible for defocusing had a thermal origin. More important, he was able to quantify the effect and use it to make accurate measurements of trace absorption.

Returning to Berkeley in 1964, Whinnery set about to build a quantum electronics graduate program and recruit new faculty and students. In a relatively short time he and his faculty colleagues put in place a program that encompassed a wide scope of research activity that included basic physical mechanisms of laser action, surface acousto-optic modulation, liquid crystal modulators, and ultrashort optical pulse generation by mode locking. Over time John expanded the scope of this activity to include research on semiconductor laser arrays, surface emitting semiconductor lasers, and picosecond optoelectronics. Although applications were a motivating theme, Whinnery and his students usually blended a strong focus on the fundamental science with a keen eye toward potential uses, especially in communications and information systems.

An important hallmark of Whinnery's approach was the highly interactive and cooperative environment that he fostered among his students and collaborators. His students frequently comment on the rather unique intellectual environment that he created. It was highly interactive, intellectually challenging, very competitive, and yet it was extremely cooperative, nurturing, and motivating. This is almost certainly due to John's remarkable personal style, which consisted of a

unique blend of intelligence, compassion, humility, humor, and wisdom. He usually did not explicitly tell his students what to do, nor did he tell them that they were wrong (or right); but for every proposal or result that a student reported he provided at least one thoughtful question and thereby stimulated a process of self-examination. This was a key element of the experience of being one of Whinnery's students—an experience that produced lifelong benefits.

John's students have been very successful in their careers. Seven became members of the National Academy of Engineering and three were also elected members of the National Academy of Sciences. Many have pursued academic careers: Etan Bourkoff at Baruch College; John Buck at Georgia Tech; Connie Chang-Hasnain at UC Berkeley; Mordehai Heiblum at the Weizmann Institute; Chenming Hu at UC Berkeley; Erich Ippen at MIT; Omar Teschke at Universidade de Campinas (State University of Campinas), Brazil; Ted van Duzer at UC Berkeley; and Amnon Yariv at Caltech. Others have gone on to highly successful careers in industry, such as Mal Currie, former CEO of Hughes; Ron Schmidt, cofounder and Chief Technology Officer (CTO) of Synoptics; Leonard Braverman, CEO of Universal Voltronics; and Frank Dabby, founder and CEO of ASI Silica Machinery. It is noteworthy that students of other faculty members closely associated with Whinnery also benefited greatly from interacting with him and have gone on to highly successful careers, such as Charles Shank, who served as director of the Lawrence Berkeley National Laboratory from 1989 to 2004.

During Whinnery's four-decade academic career at UC Berkeley, he was given the rare honor of being named University Professor, a special designation as a "professor-at-large" for all University of California campuses, which is considered the UC system's most prestigious recognition

of scholarship. Only 36 faculty members—14 of them from UC Berkeley—have been given that title since it was first awarded in 1960.

During leaves from the university, Whinnery held positions as head of the Microwave Tube Research Division of the Hughes Aircraft Company from 1951 to 1952, participated in research in quantum electronics at Bell Laboratories in New Jersey from 1963 to 1964, and held visiting professorships at UC Santa Cruz and Stanford University. In 1959 he held a Guggenheim Fellowship at the Swiss Federal Institute of Technology in Zurich.

In recognition of Whinnery's research contributions, excellence as an educator, and record of service to the nation, President George H. W. Bush awarded him the National Medal of Science, the nation's highest scientific honor, in 1992. The many other awards and honors Whinnery won over his lifetime include the Founder's Award of the National Academy of Engineering, Medal of Honor of the Institute of Electrical and Electronics Engineers, Lamme Medal of the American Society for Engineering Education, Berkeley Citation, and the Distinguished Engineering Alumnus Award. He was also elected to both the National Academy of Sciences and the National Academy of Engineering, and he served on the National Aeronautics and Space Administration's Science and Technology Committee on Manned Space Flight for the Apollo Space Program. In 2007, 20 years after Whinnery retired from UC Berkeley, the Department of Electrical Engineering and Computer Sciences dedicated a room in the campus's Cory Hall as the John R. Whinnery Room.

Friends and colleagues point out that despite his achievements Whinnery remained remarkably unassuming. This sentiment is no better captured than by his longtime friend and colleague Don Pederson, who wrote in the forward to the Oral History conducted by the University of California

in 1994: "[A]ll who know him will attest that there is no kinder, more gentlemanly soul than John Whinnery. His many talents, worn with such humility and humanity, make him a cherished friend and compatriot."

Outside of his professional life Whinnery was known for his love of writing poetry and children's stories, cultivating fine wines, and hiking in the mountains; he was also an enthusiastic golfer. He loved spending weekends on California's north coast with his family and friends.

Whinnery was preceded in death in 2007 by Patricia, his wife of 63 years. He is survived by three daughters, all living in California: Carol Whinnery of Torrance; Dr. Cathy Whinnery of Berkeley; and Barbara Whinnery of Santa Monica; and three granddaughters.

REFERENCES

In Memoriam. 2009. University of California, Berkeley. Used with the permission of the Academic Senate of the University of California.

John R. Whinnery, An Oral History. 1994. Regional Oral History Office, Berkeley, Calif.: The Regents of the University of California.

John Whinnery. An Oral History. 1993. Conducted by Andrew Goldstein, IEEE History Center, New Brunswick, N.J.

SELECTED BIBLIOGRAPHY

1944

With H. W. Jamieson. Equivalent circuits for discontinuities in transmission lines. *Proc. IRE* 32:98-114.

With S. Ramo. A new approach to the solution of high-frequency field problems. *Proc. IRE* 32:284-288.

1953

With C. K. Birdsall. Waves in an electron stream with general admittance walls. *J. Appl. Phys.* 24(3):314-323.

1964

With J. P. Gordon and R. S. Moore. Low absorption measurements by means of the thermal lens effect using an He-Ne laser. *Appl. Phys. Lett.* 5(7):141-143.

1974

Laser measurements of optical absorption in liquids. Accounts Chem. Res. 7:225-231.

1987

With C. J. Chang-Hasnain, J. Berger, D. R. Scifres, W. Streifer, and A. Diennes. High power with high efficiency in a diode laser array in an external cavity. *Appl. Phys. Lett.* 50:1466-1467.

1993

With X. Wu, K. H. Gulden, M. Thomas, J. S. Smith, S. Malzer, P. Kiesel, M. Kneissl, and G. H. Döhler. Hetero-*nipi* band filling modulator with laterally interdigital contacts made by shadow mask molecular beam epitaxy regrowth. *Appl. Phys. Lett.* 62:152.

With X. Wu, K. H. Gulden, M. Thomas, G. Wilson, J. Walker, G. H. Döhler, and J. S. Smith. Selectively masked MBE regrowth. *J. Cryst. Growth* 127:896-899.

1994

With S. Ramo and T. Van Duzer. *Fields and Waves in Communication Electronics.* 3rd ed. New York: Wiley.

1995

Lasers for optical communication. In *Encyclopedia of Telecommunications: Introduction to Computer Networking to Methods for Usability Engineering in Equipment Design*, vol. 10, eds. F. E. Froehlich and A. Kent, 1st ed., pp. 209-232. New York: Marcel Dekker.

1996

Review of some photothermal effects. In *Amazing Light—A Volume Dedicated to Charles Hard Townes on His 80th Birthday*, ed. R. Y. Chiao, p. 643. New York: Springer-Verlag.