

WALTER GUYTON CADY

SIDNEY B. LANG

Ben-Gurion University of the Negev, Beersheva, Israel

(Received March 3, 1975)

Professor Walter Guyton Cady died on December 9, 1974, the day before his 100th birthday. Professor Cady, best known for his discovery of the principle of the crystal oscillator and his monumental treatise *Piezoelectricity*, well deserves the title of the "Father of Modern Piezoelectricity".

Cady was born on December 10, 1874, in Providence, Rhode Island. He studied at Brown University, receiving the Ph.B. degree in 1895 and the M. A. degree in 1896. His master's thesis on the dynamic behavior of a top with a blunt tip was carried out under the direction of Carl Barus. During this time Cady published his first paper, on the determination of the volume of an airbulb thermometer. He continued his graduate studies at the University of Berlin receiving the Ph.D. degree in 1900. His thesis was a study of the energy of cathode rays, under the direction of Warburg and Walter Kaufmann.

Upon his return to the United States, Cady joined the U.S. Coast and Geodetic Survey and became the head of a magnetic observatory in Maryland. During this time he published his first completely independent work on a direct recording magnetic variometer. In 1902 he joined the Physics Department of Wesleyan University in Middletown, Connecticut. He rose to the rank of Assistant Professor the next year and became Professor and Head of the Physics Department in 1907. He remained at Wesleyan University until 1951, becoming Professor Emeritus in 1946. During his early years at Wesleyan he studied arc and glow discharges between metallic electrodes.

Professor Cady's interests in piezoelectricity were first aroused in 1917. The German submarine menace in World War I had reached very severe proportions. A conference sponsored by the National Research Council was convened in Washington on June 14-16, 1917 under the leadership of Robert A. Millikan to discuss the problem. Cady was invited to the conference because of his interests in submarine detection with ultrasonic waves produced by a magnetostrictive generator. At the conference, the French delegates

announced that Paul Langevin had been generating and detecting ultrasonic waves under water by means of quartz-steel "sandwich" transducers. As a result of the meeting, Cady's research interests permanently turned to piezoelectricity. He first collaborated with a General Electric group studying quartz and Rochelle salt crystals in 1917 and then with a Columbia University group where he worked on Rochelle salt hydrophone receivers designed to resonate at the transmitted frequency. These studies culminated in field tests at the Navy Yard in Key West, Florida in 1918 and the Naval Station in New London, Connecticut in 1918-1919.

During the course of his tests in 1917 and 1918, Cady noticed the effect on the driving circuit of a quartz crystal when the frequency was close to the natural mode of vibration of the crystal. On February 26, 1921, Cady described a piezoelectric resonator at a meeting of the American Physical Society and suggested that it could be used as a standard of frequency, a filter, or a coupling device between circuits. Immediately after, he began the investigation of the control of the frequency of an oscillator by means of a crystal. A description of the first piezo-oscillator circuit, using a 39-mm long quartz bar oscillating in a longitudinal mode at about 70,000 Hz, was presented to the American Physical Society on December 28, 1921.

Cady took his only sabbatical leave from Wesleyan in 1923 to travel to Europe for an inter-comparison of quartz resonators, calibrated at the National Bureau of Standards, with frequency standards at the national laboratories of Italy, France, and England. During the next twenty years, Cady concentrated his efforts on the piezo-resonator and the piezo-oscillator as well as on fundamental piezoelectric studies, with special emphasis on Rochelle salt. In the early 1930's, Cady planned to write a short monograph on piezoelectricity. But upon a suggestion by F. K. Richtmyer, he extended it into a full-length book, the monumental *Piezoelectricity*, first published in 1946. The book was

revised and republished in 1964, and, even today, is still so relevant that every researcher in the field makes use of it.

Cady's services were required for underwater detection problems again immediately after the attack on Pearl Harbor in World War II, and he spent a short period at the Naval and Sound Laboratory in San Diego in 1941. In 1945, he worked for the Radiation Laboratory in Cambridge, Massachusetts, on quartz transducers for radar trainers. After World War II and his official retirement, Cady remained at Wesleyan studying transducer theory, methods of measurement, and acoustic-radiation pressure with the support of the Office of Naval Research. He worked at the California Institute of Technology from 1951 to 1955 on problems of resonator and filter theory and measurement of acoustic power. In his 1955 experiments, he produced acoustic waves at a frequency of 3000 MHz. Cady continued an active life, publishing a mathematical paper on the circular tractrix in 1965 and receiving patents on a piezoelectric vibrator in 1968 and on a detector of mechanical vibrations in 1973.

Professor Cady was active in a number of societies including the American Physical Society, the American Association for the Advancement of Science, the American Institute of Electrical Engineers, and the

Institute of Radio Engineers of which he was president in 1932-1933. He was a member of several committees of the National Research Council and was a Lieutenant Commander in the U.S. Naval Reserve. Among the honors awarded him were the Liebmann Memorial Prize of the Institute of Radio Engineers in 1928 and the 1937 Duddell Medal of the Physical Society of London. He received honorary Sc.D. degrees from Brown University in 1938 and Wesleyan University in 1958.

Walter Guyton Cady wrote, "In experimental work I have learned the value of making a special study of obstacles, hindrances, and disturbing factors, to see if they can be made to serve a useful purpose. In other words, to convert stumbling blocks into stepping stones". Professor Cady's stepping stone of the piezoelectric oscillator continues today to enter our laboratories and enrich our lives through devices as diverse as quartz thermometers, film-thickness gauges, piezoelectric chemical detectors, and quartz watches.

ACKNOWLEDGEMENTS

Appreciation is expressed to the Niels Bohr Library, Center for History of Physics, American Institute of Physics, for permission to use the Cady collection.