

**MEMORIAL RESOLUTION OF THE FACULTY
OF THE UNIVERSITY OF WISCONSIN-MADISON**

ON THE DEATH OF PROFESSOR EMERITUS CLARENCE S. CLAY

Professor Emeritus Clarence Clay died suddenly April 4, 2011. Known to friends simply as “Clay,” he was a member of the faculty of the Department of Geoscience for 21 years. He grew up in Kansas and began his college education at Kansas State University but left to serve in the Army during World War II. After basic training, he was placed in specialized programs at the University of Cincinnati and Ohio State University. He was then assigned to the Signal Corps to maintain and operate electronic equipment. While in Ohio, he met Jane Edwards and, after completion of Clay’s training, they were married in 1945. Clay’s group was chosen to maintain electronic equipment during the planned invasion of Japan.

After separation from the Army, Clay completed both the bachelor’s (1947) and master’s (1948) degrees in physics at Kansas State University. The Clays then moved to Madison where he entered the university’s PhD program in physics. His dissertation under Professor Gibson Winas was entitled, “Field Strengths and Spectra of High Frequency Gas Discharges.” After completing the PhD in 1951, Clay taught for one year at the University of Wyoming but then joined the Carter Oil Company Research Laboratory in Tulsa, Oklahoma, as a research physicist to develop new methods for geophysical exploration. In 1955, Clay moved to the Hudson Laboratories of Columbia University where he was a senior research associate for marine geophysical research. There, Clay worked in an unusually stimulating group specializing in marine acoustics. Among many accomplishments at Hudson, the group located several important U.S. and Russian sunken ships. With his colleague, I. Tolstoy, he coauthored an important monograph on ocean acoustics, published in 1966.

Clay applied his considerable mathematical skills to solving problems in signal processing that led to five patents between 1959 and 1967. His inventions show a remarkable prescience. For example, his 1959 patent for a “multiple transducer array . . . of particular utility in the area of seismic prospecting” has been referenced as recently as 2000 by several petroleum companies. His 1964 patent for “Signal Correlation Method and Means” for “oceanic depth measurement” refers “not only to measurements of the depth of the water, but also to the depth measurements of the earth layers below.” It led, years later, to a Navy sonar project for mapping the ice pack floating in the Arctic Ocean to determine if submarines could safely navigate beneath the ice. Similarly, the 1967 patent for “Directional Filtering of Summed Arrays” for “maximization of signal output by means of a matched-filter technique” with Robert A. Frosch explicitly recognizes the mathematical similarity between sound waves in water and electromagnetic waves in air. Indeed, the patent refers to the sonar and radar “arts,” respectively, anticipating — before digital computers — many techniques, such as “time reversal,” that continue to see widespread application and extensive research today.

Clay joined the geophysics faculty at the UW-Madison in 1968. He taught introductory geophysics to scores of students, and he mentored many graduate students who today hold important positions in academia and industry around the world. His extensive ocean acoustics experiences led to an interest in fish acoustics. As faculty members in the graduate program in oceanography and limnology, Clay and Professor John Magnuson discovered a mutual interest in tracking aquatic organisms. They developed a fruitful collaboration involving graduate and post-doctoral students from their respective specialties to conduct cruises off Cape Hatteras using acoustical techniques to study the distribution of organisms along the northern edge of the Gulf Stream front. They then extended their research over deeper water beyond the Continental Shelf. Clay also conducted a geophysical survey for an antenna array in northern Wisconsin used for extremely low-frequency (ELF) communication with ships anywhere on Earth. Although practical, this technology became controversial with both environmentalists and marine zoologists.

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While at UW-Madison, Clay published a second edition of the Tolstoy and Clay monograph and two editions (1977 and 1998) of another monograph on acoustical oceanography with former Hudson colleague, H. Medwin. Those two books have appeared in Russian translations and are the international standard references for marine acoustics. Clay also published a textbook for exploration seismology (1990). In 1993, the Acoustical Society of America recognized Clay's preeminence by awarding him its prestigious Silver Medal "for contributions to understanding acoustic propagation in layered waveguides, scattering from the ocean's boundaries and marine life, and ocean parameters and processes." His contributions are listed in detail on Wikipedia.

Like many mathematicians, Clay possessed an intuitive appreciation for music. He began playing the euphonium and singing in choruses as a youth and continued through adulthood. He and Jane, who plays the clarinet, joined the New Horizons Band for people over 50 years old. Clay also played in the Madison Community Orchestra. Both he and Jane sang in the First Unitarian Society choir for many years.

Clay continued his scientific pursuits after retiring in 1989. He participated in a chaos seminar led by Professor Clint Sprott and also explored fractals. He found that fractals describe wind-blown ocean waves, seafloor sediment surface features, and many aspects of the land surface. His last interest was in climate change. To look into the future, he was analyzing records over the last 800,000 years, using spectral algorithms that he characteristically insisted on re-deriving from Fourier's first principles. Although the shortening of Madison winters since the 1920s and the rapid shrinkage of the Arctic Ocean ice cover indicate warming, Clay became convinced, based upon his understanding of the orbital cycles identified by Milankovitch that, in the longer run, we are on the cusp of a new ice age.

The Clays raised four children of whom Clay was very proud. While living in New York State, the family took up sailing on the Hudson River in the summer and skiing in the winter. When they came to Wisconsin, both Clay and Jane served for many years on a ski patrol. Attending to injured skiers inspired Jane to obtain a degree in nursing after which she served as a registered nurse, certified at the University Hospital. The Clays were always active members of the First Unitarian Society of Madison, of which Jane was president of for a number of years.

Clay was always generous with his time and patient in sharing his knowledge. He was positive, considerate, genuinely interested in other people, and never tried to force his opinions on others. Even when the family was struck by tragedies of the most profound sort, Clay remained joyous in life.

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