DAVID T. BLACKSTOCK
1930–2021
Elected in 1992

“For fundamental contributions to the principles of propagation of finite amplitude sound, and their application in various engineering fields.”

BY JOSEPH J. BEAMAN AND MARK F. HAMILTON

DAVID THEOBALD BLACKSTOCK died at the age of 91 on April 30, 2021, in Austin, Texas, where he was born, raised, and spent most of his life. He was known internationally as an eminent scholar in acoustics, a mentor to both junior and senior acousticians, and an extraordinarily caring man.

He was born February 13, 1930, to Leo and Harriet Blackstock in Austin and grew up mostly in the Hyde Park neighborhood with his older brother Mathis. After receiving BS and MS degrees in physics at the University of Texas (UT) at Austin, David served 2 years in the US Air Force, then joined Frederick V. Hunt’s group at Harvard University and earned a PhD in applied physics in 1960. He wrote his dissertation on the subject of nonlinear acoustics, a field in which he continued to work throughout his career.

After 3 years at General Dynamics and 7 years as associate professor of electrical engineering at the University of Rochester (NY), in 1970 David returned permanently to UT. Initially he worked at the university’s Applied Research Laboratories, a leading research center in underwater acoustics, until in 1987 he became professor of mechanical engineering, a position he retained until 2000, when he retired with the title E.P. Schoch Professor Emeritus.
David’s most important contributions were in nonlinear acoustics, which involves sound so intense that waveforms distort as they propagate; examples are explosion waves and intense sound beams used in therapeutic ultrasound. His seminal work in the 1960s, in parallel with work by academician Rem Viktorovich Khokhlov at Moscow State University in the former Soviet Union, established a foundation for nonlinear acoustics that is still employed today.

David popularized the use of the Burgers equation for modeling the nonlinear propagation of sound, an approach that permits the effects of nonlinear distortion and energy loss to be combined. He also developed a consistent framework that incorporates models for waveform steepening and weak shock theory developed by others in a way that permits analytical solutions for a variety of practical cases.

Among other theoretical contributions in the 1960s, David developed a solution revealing that a limit for the amplitude of a sound wave exists no matter how powerful the sources. The phenomenon is called acoustic saturation, a notable example of which is the limit on intensities that can be used in underwater sonar.

He also showed how two well-known and seemingly unrelated classical solutions derived in the 1930s—one for waves of finite amplitude in the preshock region, the other for sawtooth shock waves—are limiting cases of a single, more general solution for the propagation of finite amplitude sound. This overarching theory came to be known as Blackstock’s bridging function.

Beginning in the 1970s, David performed research with his graduate students that combined theoretical, experimental, and computational approaches to a wide range of applications in nonlinear acoustics, including sonar, jet noise, parametric arrays, sonic booms, sound-sound interaction, and therapeutic ultrasound. For example, by implementing David’s formulation of weak shock theory in a computer code, doctoral student Mike Pestorius became the first to model the propagation of high-intensity noise fields containing shocks. The remarkable agreement they achieved with their measurements of
waveform distortion, shock formation, and shock coalescence remains a benchmark contribution to nonlinear acoustics in general and the jet noise community in particular.

Then in the mid-1970s, with master’s student Mary Beth Bennett, David proved the existence of the parametric array phenomenon in air, which involves the use of inaudible ultrasound to generate superdirectional audio frequency sound. Audio parametric arrays in air, now called audio spotlights, are encountered in venues ranging from museums to trade shows, wherever transmission of speech with laser-like directionality is desired.

David’s reputation extended far beyond the United States, even impacting Soviet scientists working in acoustics beginning in the 1970s, when mere communication with that community was challenging at best. He nevertheless managed to support their work and facilitate interaction with their counterparts in the West. As a result, in the 1990s after the fall of the Berlin Wall, a steady stream of the most famous Russian scientists working in nonlinear acoustics visited UT Austin.

In the 1980s David began receiving national recognition for his contributions in acoustics. These included, from the Acoustical Society of America (ASA), the Silver Medal in Physical Acoustics (1985), Gold Medal (1993), and Rossing Prize in Acoustics Education (2007); election to the NAE in 1992; and in 2015 the Per Brüel Gold Medal in Noise Control and Acoustics from the American Society of Mechanical Engineers.

He served as president of the ASA, which was his professional home, and also as chair of the International Commission for Acoustics, the “united nations” for acoustical societies around the world. For the National Academies of Sciences, Engineering, and Medicine and National Research Council, he served four terms on the Ford Foundation Diversity Fellowships Predoctoral Review Panel on Engineering. He was also a member of the Ford Foundation Fellowships Review Panel on Engineering (2017–18) and an ex officio member of the US Liaison Committee for the International Union of Pure and Applied Physics.
Beyond David’s intellectual contributions to acoustics, his teaching and graduate student supervision are legendary. He could succinctly and lucidly explain complex phenomena to students of varying abilities, not only in the classroom but also in his widely used textbook, *Fundamentals of Physical Acoustics* (John Wiley & Sons, 2000).

He was also known for precise grading, and he would even correct grammar on homework assignments. The seemingly unending corrections of doctoral dissertation chapters in his signature green ink taught students to think logically and write clearly, resulting in dissertations that are models of perfection. His strong drive to build a sense of community among students ranged from playing soccer with them at lunchtime to a program in which he organized lunch dates for students to meet with senior researchers at ASA meetings.

In fact, despite all the international recognition David received, he felt most honored when the ASA Student Council in 2019 renamed its David T. Blackstock Mentor Award (he had been the first recipient of the Student Council Mentor Award in 2004). His reaction showed his humility and the importance he placed on helping young acousticians achieve their dreams.

Since the late 1990s one of David’s greatest pleasures was acting as a scientific advisor for a National Institutes of Health project grant on lithotripsy, a nonsurgical procedure that disintegrates kidney stones with shock waves. The multidisciplinary talent in this group appealed greatly to David’s scholarship and scientific curiosity. His attendance at the annual review meeting in January 2020 was David’s last participation in a scientific conference.

David’s wife of 64 years, Marjorie (née Goodson), died December 8, 2019. They had met while he was on a tour of duty at Wright Patterson Air Force Base. His remarkable career would not have been possible without her support. They are survived by their four children, Silas, Susan, Stephen, and Peter; six grandchildren; and five great-grandchildren.