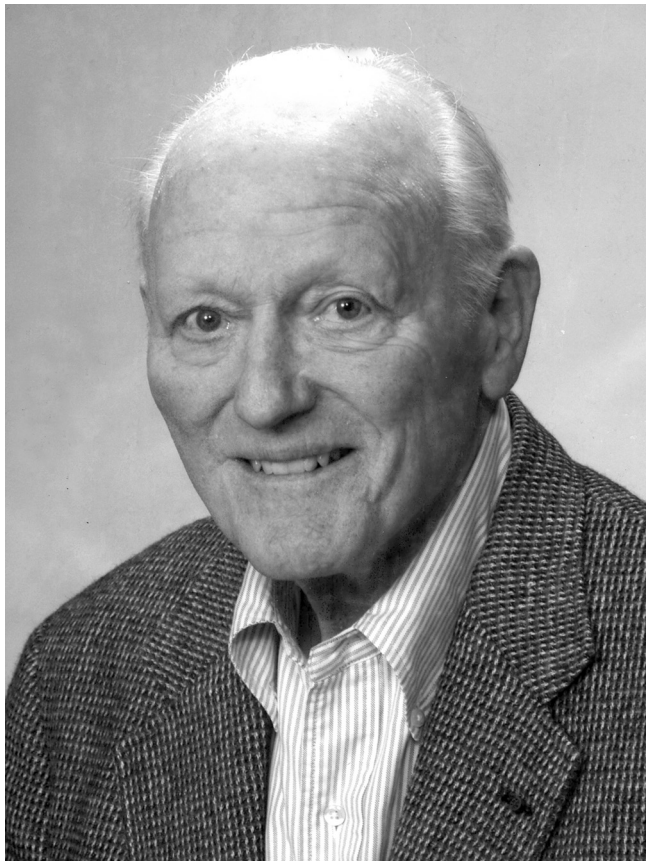

COLEMAN DUPONT DONALDSON

1922–2009

Elected in 1979

"For research on supersonic diffusers, viscous vortex motion and turbulent transport phenomena, with application to solution of practical engineering problems."

BY DENNIS M. BUSHNELL

COLEMAN DUPONT DONALDSON, a giant in the development of aerospace and founder of Aeronautical Research Associates of Princeton, New Jersey, died August 7, 2009, at his home in Newport News, Virginia, at the age of 86.

Coleman Donaldson was elected to the National Academy of Engineering in 1979, "for research on supersonic diffusers, viscous vortex motion and turbulent transport phenomena, with application to practical engineering problems."

Dr. Donaldson was born on September 22, 1922, in Philadelphia to John Wilcox and Renee duPont Donaldson and was a grandson of Thomas Coleman duPont, president of E. I. duPont de Nemours and Company. He evidenced early on an intense lifelong interest in aviation, building a reproduction airplane on the roof of a barn at his parents' home and spending many hours "flying it." His father was an early naval aviator. He maintained a multiengine instrument pilot rating until very late in life. Aeronautics/aviation and aerospace defined the vast majority of his life's work and were a major personal passion.

Donaldson graduated with a B.S. in aeronautical engineering from Rensselaer Polytechnic Institute in 1942. He earned both master's (1954) and doctoral (1957) degrees in aeronautical engineering from Princeton University, where he was a

student of Luigi Crocco. After graduation in 1942, he entered the U.S. Army Air Corps and was assigned to Wright Field and eventually the NACA Langley Memorial Laboratory in Hampton, Virginia. Donaldson began his aeronautical research career in these government laboratories and served as head of the Langley aerophysics section of the Gas Dynamics Laboratory from 1946 to 1952, when he left to pursue graduate education at Princeton University. There he founded, in 1954, Aeronautical Research Associates of Princeton, where he served first as president of the company and later as chairman of the board, until it was sold to the Titan Corporation in 1986. He then moved to his waterfront farm on the York River in southeastern Virginia and became a consultant to the federal government and industry. (The farm has been identified by archeological study as the site of the famous Captain John Smith–Pocahontas interaction in the early 1600s.) During his years at Princeton, Donaldson served as associate editor and, later, general editor of the landmark 12-volume Princeton series "High Speed Aeronautics and Jet Propulsion," reporting to Theodore Von Karman. These extraordinary volumes were the "bible," the resource reference during initiation of the Aerospace Age.

During his long research career, Coleman Donaldson contributed to an amazing variety of technical areas, including rarefied flow effects; MHD; flow separation; imperfect gas effects; transonic and supersonic aerodynamics (1940s to 1950s); weapons, hypersonics, and associated thermal protection issues (1950s to 1960s); wake vortices for both aircraft and submarines (1950s to 1980s); armor and antiarmor (1970s to 1980s); and the recurrent theme throughout most of his technical career—transition and turbulence modeling and associated computational fluid dynamics developments (1950s to 1980s). In his work on transonics in the 1940s, Donaldson developed an annular transonic facility, measured the first pressure distributions at Mach 1, and contributed to the development of the Bell X-1 and X-2 aircraft. He invented an active thermal protection approach which was sufficiently effective that the surface would not discolor during testing

(one of his patents). He is credited with being a major force in the Navy's development of computational fluid dynamics as a ship/submarine design tool. He was the national expert on the aeronautical wake vortex hazard, with major contributions to research that enabled the safe entry of the 747 ("Heavy") class of aircraft into airline service.

Also in the vortex flow arena, Donaldson published a groundbreaking series of papers on three-dimensional Navier Stokes solutions for cylindrical vortices, indicating the possibilities of adjacent solution states, which could lead to bifurcations, providing insights into vortex-bursting phenomena. He developed the canonical testing approach to evaluate advanced armor materials, which is still in use today, and he invented an improved projectile/penetrator.

Perhaps his most substantial and best-known works involved second-order closure for modeling of transitional and turbulent flows. These works were employed for a wide variety of national security problems as well as civilian applications. His work decoupled the modeling of turbulent fluxes from unique dependence on mean flow and led to very extensive subsequent worldwide research and application efforts in the field. Application examples of this body of work include the evaluation of atmospheric particulate effects on U.S. Air Force intercontinental ballistic missile reentry vehicle boundary layer transition, pollution/effluent dispersion in the atmosphere and estuarine systems, and chemically reacting system understanding and optimization.

Donaldson's many honors include membership in the National Academy of Engineering. He was a fellow of the American Institute of Aeronautics and Astronautics (AIAA) and the Explorers Club. He received the Meritorious Public Service Award from the Chief of Naval Research and the AIAA Dryden Research Lecture Award. He was chosen to serve as Robert H. Goddard Visiting Professor at Princeton University and as general chairman of the AIAA's 13th Aerospace Sciences Meeting. Donaldson was a member of Sigma Xi and the American Physical Society. His committee service included the Advanced Research Projects Agency Submarine

Technology Advisory Panel; the Advisory Committee for the National Aeronautics and Space Administration (NASA)-Stanford Center for Turbulence Research; the Naval Research Advisory Committee; the NASA Special Panel on Hypersonic Flow, Advisory Council; the Department of Aerospace and Mechanical Engineering, Princeton University; the Industrial Professional Advisory Council; the College of Engineering, Pennsylvania State University; the NRAC Laboratory Advisory Board for Air Warfare and Marine Corps Panel; the NASA Research and Technology Advisory Council; the President's Air Quality Advisory Board; and the NACA Special Subcommittee on Aircraft Noise, under General James H. Doolittle.

Coleman Donaldson had many personal passions, including flying, sailing, building and repairing period furniture, supporting in many ways historic preservation, playing the piano and guitar, dancing, and tennis. He was a voracious reader and a student of Jefferson, Washington, Madison, Churchill, Gandhi, and other statesmen. His favorite furniture periods were Queen Anne and Chippendale. He sailed competitively in several Miami-to-Nassau races, including a stint as a crew member for Bus Mosbacher, winner of the America's Cup, and he cruised the Chesapeake Bay on his Staysail schooner. He was a staunch supporter of the Association for the Preservation of Virginia Antiquities and the National Trust for Historic Preservation.

Coleman Donaldson is survived by his wife of 64 years, Barbara Goldsmith Donaldson of Newport News and five children—Beirne Donaldson of Mendham, New Jersey; Coleman Donaldson, Jr., of Agoura Hills, California; Evan Donaldson of McLean, Virginia; Alexander Donaldson of Rayleigh, North Carolina; and William Donaldson of Newport News—as well as a brother, a sister, and eight grandchildren.

Among his most valuable services to the nation was as a superb critic and reviewer. Donaldson combined a masterful grasp of the fundamentals with a personality that was not bashful and provided the national security community with invaluable advice, along with many unique solution

approaches for critical national problems. Overall, his was a wonderful, exceedingly productive, long life, lived well. We are still working on his ideas.