



David Middleton

DAVID MIDDLETON

1920–2008

Elected in 1998

“For statistical communication theory and applications.”

BY THE FAMILY OF DAVID MIDDLETON
AND JOSEPH W. GOODMAN

DAVID MIDDLETON, a physicist whose original research led to major advancements in the understanding of communication systems—from radar during World War II to the wireless communication systems of our present age—died on November 16, 2008, in New York City. He was 88.

Born in New York City in 1920, Dr. Middleton graduated from the Harvey School in 1934 and Deerfield Academy in 1938. He received his undergraduate and graduate degrees in physics from Harvard College (A.B., 1942, summa cum laude) and Harvard University (M.A., 1945; Ph.D., 1947).

Dr. Middleton was a scientist, a researcher, and a founder of the field of statistical communication theory. He devoted his entire career, spanning six decades, to studying signal processing and the transfer of information from one point in space-time to another, with numerous applications in radar, underwater listening devices, satellite technology, and signal processing.

His career began in 1943 at the Harvard Radio Research Laboratory as special research assistant to Professor J. H. Van Vleck (later a Nobel Laureate in physics), with whom he took his Ph.D. in 1947. Together, Dr. Middleton and Van Vleck

(and simultaneously but independently, D. O. North at RCA Laboratories) developed the matched-filter principle critical to data communications and an enduring concept in the field today. In 1943 Dr. Middleton began the analysis of signals and noise passing through nonlinear devices, such as the “chaff,” or aluminum strips, used to jam radar signals in order to protect American ships and aircraft from detection by the enemy.

As an assistant professor of applied physics at Harvard University (1949–1954), he introduced new courses on statistical communication theory and processing signals in noise. He also served as adjunct professor at Rensselaer Polytechnic Institute and the universities of Columbia, Johns Hopkins, Texas, Rice, and Rhode Island, where he supervised a number of doctoral students and made major contributions with them.

From 1954 to 2008 Dr. Middleton was a consultant to universities, industry, and the federal government. During the Cold War era of the 1950s through the 1980s, Dr. Middleton’s theoretical work for the government was applied to antisubmarine warfare systems, in particular to passive and active sonar systems to track Soviet submarines. During the détente of the 1970s, when U.S. and Russian scientists began pursuing joint projects, he served as scientific editor for several Russian texts in his field and made presentations in the former Soviet Union, where he was officially recognized and highly regarded in his field.

Published in 1960 and widely translated into many languages, Dr. Middleton’s seminal work, *An Introduction to Statistical Communication Theory* (McGraw-Hill; reprint editions with new author’s prefaces issued in 1987 by Peninsula Publishing and 1996 by IEEE Press, now distributed by Wiley-IEEE Press), played a major role in integrating statistical methods into the education of engineers in communications, radiolocation, and related fields. Leon Cohen, professor of physics at Hunter College in New York, has used the book since graduate school 45 years ago. He writes: “Dr. Middleton’s book is one of those texts that is so extraordinary for its clarity and depth that one marvels at it and the author. It is perhaps the greatest book ever written on noise, probability theory, and stochastic

processes. . . . The classic book on noise, written with style and elegance, [it] covers a panoramic view unmatched by any other publication."

Dr. Middleton's work in statistical communication theory included the handling of random processes and the application of decision theory to signal detection and estimation. In statistical physics he contributed to a greater understanding of propagation and scattering in random media, with an emphasis on the underwater environment. After 1968 his work expanded to include electromagnetic compatibility, with particular attention to non-Gaussian noise and interference models, and non-linear signal processing for man-made and natural electromagnetic and acoustic environments.

He served on the U.S. Naval Advisory Research Committee (1970–1977) and the Scientific Advisory Board of the Supercomputing Research Center, Institute of Defense Analysis (1988–1991).

Dr. Middleton published a second book, *Topics in Communication Theory* (McGraw-Hill, 1965), and over 170 papers. Significant among them is his 2002 paper, "New Results in Applied Scattering Theory," which contains a synthesis of his methods for determining the statistical characteristics of non-Gaussian noise affecting signal reception. These methods have contributed to solving long-time, complex problems in radar, sonar, and radio astronomy, as well as problems where non-Gaussian noise is often encountered.

At the time of his death, he was actively working on his last book, *Elements of Non-Gaussian Statistical Communication Theory: A Space-Time Treatment* (to be published posthumously). A sequel to his first book, it summarizes his work of over 65 years in statistical communication theory and presents results from more recent research gained by adding non-linear effects and time analysis to earlier methods.

Dr. Middleton was a fellow of several scientific societies, among them the Institute of Electrical and Electronics Engineers (IEEE), the American Physical Society, the Acoustical Society of America, the American Association for the Advancement of Science, the New York Academy of Sciences, and the

Electromagnetics Academy. He was elected to membership in the National Academy of Engineering in 1998. He received numerous prizes and awards for his work. In August 2008 the IEEE and Princeton University hosted a symposium in honor of his long and distinguished career.

For a well-balanced life, David Middleton believed in the importance of cultivating the arts and humanities as well as math and science. He was meticulous in crafting the prose for his books and papers, believing there was no excuse for scientists and engineers to be poor writers. In addition, he read widely, collecting books on history, philosophy, biography, art, and music. He listened to music from the Classical and Romantic eras and played the piano—especially Beethoven, Schubert, and Chopin—expertly and with great dexterity and feeling. Over the years he drew many elegant line drawings of imaginative scenes and characters. He loved the Cape Cod seashore, where he spent part of every year with his family, playing tennis and enjoying the ocean and walks in nature. He could tell outrageous puns and was very fond of cats.

Dr. Middleton married Nadea Butler Middleton in 1945 and raised a family with her in Cambridge and Concord, Massachusetts. They divorced in 1971. He leaves his second wife, Joan Bartlett Middleton of New York City, and four children from his first marriage, three stepsons, a niece, and three granddaughters.

