



JAMES R. WAIT

1924-1998

BY C. GORDON LITTLE AND ERNEST K. SMITH

JAMES R. WAIT, professor emeritus of the University of Arizona and a world leader in electromagnetic wave propagation theory, died October 1, 1998, in Tucson, Arizona.

James Wait was born on January 23, 1924, in Canada's capital city, Ottawa, the son of an air vice-marshal, the highest officer's rank in the Royal Canadian Air Force at that time. He enlisted in the Canadian Army in 1942 and served as a radar technician until 1945, at which time he was head of a radar maintenance group in Kingston, Ontario.

Dr. Wait attended the University of Toronto, Ontario, Canada, receiving the B.A.Sc. degree in 1948, the M.A.Sc. in engineering physics in 1949, and the Ph.D. in electromagnetic theory in 1951. His Ph.D. was based in part on research in electromagnetic methods in geophysics carried out in Jerome, Arizona, with Newmont Exploration, Ltd. His research with Newmont led to several patents for electromagnetic and induced-polarization methods of geophysical prospecting.

In 1952 Dr. Wait joined the Defense Research Telecommunication Establishment in Ottawa, Canada, as a section leader. There he conducted research primarily on radiation from electric and magnetic antennas in various media, and also on ground-and surface-wave propagation.

In 1955 Dr. Wait joined the Central Radio Propagation Laboratory (CRPL) of the National Bureau of Standards in Boulder, Colorado. Here, for the next twenty-five years, he conducted a range of theoretical electromagnetic propagation investigations of extraordinary breadth, number, and diversity, publishing over 600 papers and three books. Throughout this period he served as a stimulating colleague, consulting widely among scientists and radio engineers across CRPL's various components as they evolved under successive Department of Commerce reorganizations. Thus, following the division of CRPL into telecommunication-oriented and environmentally oriented components, he was affiliated as senior researcher both with the Institute for Telecommunication Sciences (1967 to 1980), and the Research Laboratories of the Environmental Science Services Administration (ESSA) (1967 to 1970) and its successor agency, the National Oceanic and Atmospheric Administration (NOAA) (1970 to 1980).

During this period, he also developed and maintained strong ties to the University of Colorado. In 1961 he was appointed adjunct professor of electrical engineering at the university. With the formation of the Cooperative Institute for Research in Environmental Science (CIRES) in 1967, a joint venture of the University of Colorado and ESSA/NOAA, he was appointed a permanent CIRES fellow.

By the early 1960s, he had already established himself as a prolific world leader in electromagnetic theory. Of particular significance was his book *Electromagnetic Waves in Stratified Media*, published in 1962 and republished in 1970. This text proved to be a citation classic, with over 1,500 citations in succeeding years. As a result, he received many invitations to visit other organizations. He spent a year (1961) at the Laboratory of Electromagnetic Theory in Copenhagen, Denmark, and the academic year 1966 to 1967 as a visiting professor at Harvard, and May 1971 as a visiting professor at the Catholic University of Rio de Janeiro, Brazil. Other mini-sabbaticals took him to Macquarie University in Sydney, Australia, and to Otago University in Dunedin, New Zealand, in addition to visits to Cambridge, England, and also to India and Egypt.

In 1980 Dr. Wait moved to Tucson, Arizona, where he became professor of electrical and computer engineering, with a joint appointment in geosciences, at the University of Arizona. During this period, Dr. Wait was instrumental in the growth of the Electromagnetics Laboratory into a world-class facility. In addition to electromagnetic applications in geoscience, he was also active in studies of lightning and atmospheric electricity. Some of his last papers were on the effects of “sprites” in the middle atmosphere, the electromagnetic fields produced by lightning, and the coupling of lightning electromagnetic waves to power lines. In recognition of his research and teaching influence, he was appointed to the prestigious position of Regents Professor in 1988. In 1989 he retired from the university to become a private consultant, specializing in electromagnetic methods and their use in subsurface probing.

Dr. Wait was elected to the National Academy of Engineering in 1977. He served as secretary of the U.S. National Committee for the International Scientific Radio Union (URSI) from 1974 to 1978, and as a U.S. delegate to the URSI General Assemblies in Boulder (1957), London (1960), Tokyo (1963), Ottawa (1969), Warsaw (1972), Lima (1975), and Helsinki (1978).

Dr. Wait was also active in editorial duties. He was influential in the formation in 1959 of the new journal *Radio Science*, as Section D of the National Bureau of Standards *Journal of Research*, and served as its first editor for three terms. (This journal is now published by the American Geophysical Union under the sponsorship of URSI.) He was an active member of the advisory board for URSI's (international) Radio Science Bulletin; he served as U.S. coeditor for the Pergamon Press Monograph Series on Electromagnetic Waves; as coeditor of the Institution of Electrical Engineers (UK) Electromagnetic Wave Series, and as a member of the editorial board of Pure and Applied Geophysics (Zurich). He served three terms (1964 to 1969) as associate editor of the *Journal of Geophysical Research*.

The range of Dr. Wait's contributions is well illustrated by the fields from which papers were solicited for a special issue of *IEEE Transactions on Antennas and Propagation* in his memory.

- Geophysical prospecting and induced polarization
- Scattering from cylindrical and spherical objects
- Mathematical methods in wave propagation
- Ionospheric, tropospheric, and ground-wave propagation
- Mixed-path propagation and nonuniform waveguides
- Curved surfaces and whispering gallery modes
- Rough surface scattering
- Propagation in mine tunnels
- Subsurface electromagnetics
- Propagation along conductors and cables
- Wire grids and shielding
- Impedance boundary conditions
- Transient electromagnetics
- Atmospheric electrodynamicics

Dr. Wait received numerous awards for his contributions to electromagnetics and to geophysical prospecting. In 1958, only three years after joining CRPL, he was awarded the Department of Commerce's Gold Medal for "highly distinguished authorship in the field of radio propagation." In 1962 he was elected fellow of the IRE and was awarded the Samuel Wesley Stratton Award of the National Bureau of Standards. In 1964 he received the IEEE Harry Diamond Memorial Award and the Arthur S. Flemming Award of the Washington, D.C., Chamber of Commerce. He was elected a fellow of the Institution of Electrical Engineers (UK) in 1977. He received the URSI Balth van der Pol Gold Medal in 1978, the IEEE Centennial Medal in 1984, and in 1992 the Heinrich Hertz Medal, a prestigious IEEE award that includes a gold medal, a certificate, and a check for \$10,000. In 1993 he received the Honorary Membership Award of the Society of Exploration Geophysicists. He also received achievement awards from IEEE specialist groups on geoscience and remote sensing, electromagnetic compatibility, and antennas and propagation.

Though widely recognized as an outstanding leader in his field, he was modest, friendly, unassuming, and exceptionally helpful to, and supportive of, juniors. Though offered promotions to senior management positions, he declined them; instead

he whole-heartedly devoted his talents to advancing the broad field of electromagnetic wave propagation in the terrestrial environment, donating generously his time and energy, and achieving huge success as a result.

Dr. Wait worked broadly to achieve his unique impact. First and foremost, he trained himself to work with extraordinary efficiency in the preparation of new scientific papers. As a result, he published over 830 papers and eight books in his 49-year career of writing. Second, he enjoyed interacting with and helping young scientists, whether it was one-on-one in response to some paper they had written, a talk they had presented, or in giving a course of lectures. In this way, he had an important impact on the careers of many young scientists. Third, he recognized the importance of high-quality scientific journals to the field, and therefore devoted considerable effort to national and international editorial duties. Fourth, he worked to stimulate and guide the evolution of each organization with which he was affiliated. And finally (and here we would both like to make personal tribute), he made himself available as a wise and much-valued consultant to colleagues and to management.

Dr. Wait was an avid hiker, biker, swimmer, and expert skier (he had been a member of the University of Toronto ski team as a student). He often encouraged colleagues to join him in these activities; few found they could keep up with him for long! Jim was confident and at ease with his scientific and athletic capabilities and quietly enjoyed his prowess in both fields.

Dr. Wait is survived by his wife, Gertrude; his son, George; his daughter, Laura; and three grandchildren, James, Carolyn, and Connor. He is also missed by scores of one-time colleagues and students, whose lives and careers benefited from his wise counsel and generous friendship, and indeed by all in the radio science community, a community that benefited so greatly from his many important contributions to their field.