JAMES R. WAIT

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AN ELECTROMAGNETICS SCHOLAR, A GENTLEMAN, AND A MAN OF MANY QUESTS

Jeffery T. Williams
Sandia National Laboratories

David A. Hill
National Institute of Standards and Technology

Jeffrey L. Young
Oklahoma State University

Special Session

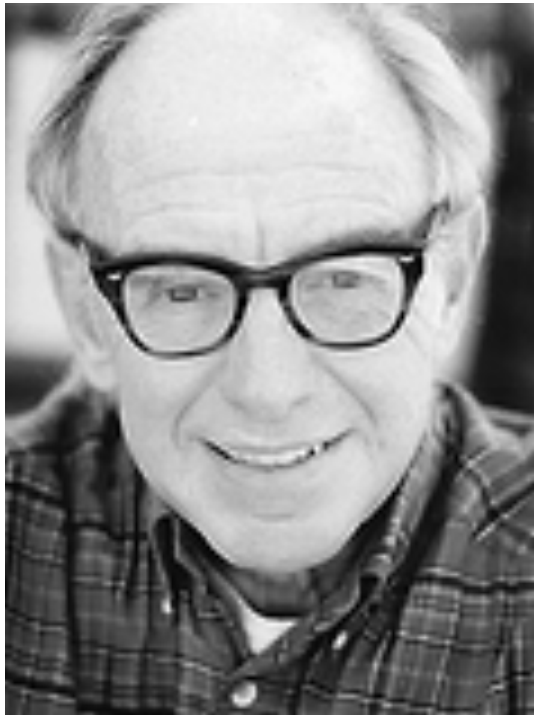
History of APS:
Early Legends of the Field

July 11, 2017

Introduction

- This is a personal remembrance of James R. Wait, an individual that had a significant impact on the lives and careers of the authors
(and so many others).

- The intent of this presentation is to offer recollections, promote recollections in others, and to motivate/inspire those who are not familiar with J.R. Wait to study his work.



Outline

- J.R. Wait's Brief Biography
- J.R. Wait's Scholarship
- J.R. Wait's Service
- J.R. Wait's Achievements
- J.R. Wait's Legacy
- Closing Remarks

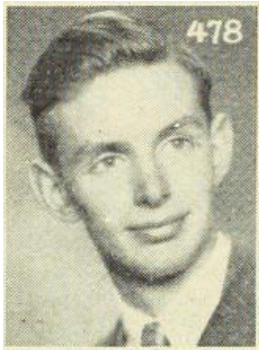
Biography: Early Years

- Born James Richard Wait on January 23, 1924 in Ottawa, Canada.
  - Father, George E. Wait, was a career Royal Canadian Air Force officer who rose to the Air-Vice Marshall, the 3rd highest rank in the RCAF

  - His youth included numerous moves between stations in Canada and England before WWII.
  - He was “sent” to Asbury College to finish high school.
  - Spent a single year at McGill College in Montreal before enlisting in Canadian Army in 1942 as an Aircraftsman (Private) as a radar technician.
  - Achieved rank of Flight (Staff) Sergeant by 1945, heading a radar maintenance unit in Kingston, Ontario.

Biography: Early Career

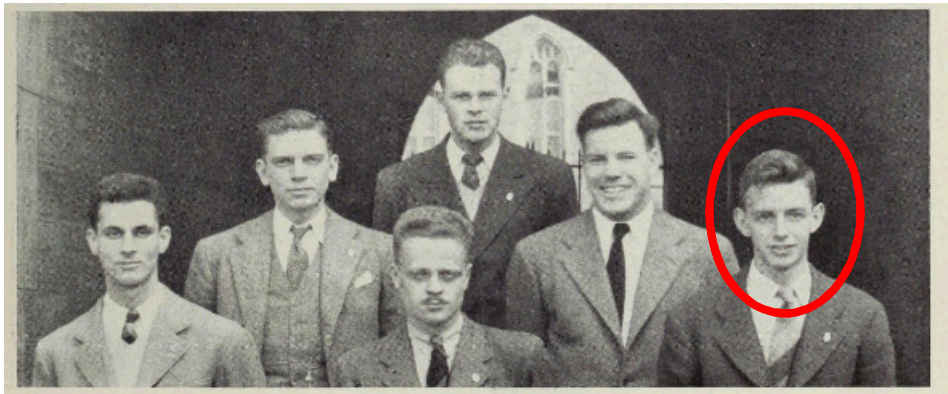
- Upon leaving the army, he enrolled in Engineering Physics at the University of Toronto
  - B.A.Sc. in 1948
  - M.A.Sc. in 1949
  - Ph.D. in 1951 (advisor Prof. George Sinclair)
- Strongly influenced by math/physics professor A.F. Stevenson.
- His Ph.D. was partially based upon work he did in electromagnetic methods in geophysics over a few summers for Newmont Exploration, Ltd. in Jerome, AZ.



JAMES RICHARD WAIT, Toronto, Ont. (478)
Eng. Physics. President 3BX Club; Varsity Ski Team 45-46.
Post-grad in physics.

Biography: The Athlete

- From youth, Jim was athletic and developed a life-long devotion to physical fitness.
- Over his entire life, his favorite sporting activity was skiing. In fact, he was a member of the varsity ski team at the University of Toronto, and was known to say that he received three degrees and a letter "T" from the university.



UNIVERSITY OF TORONTO SKI TEAM, 1945-46
A. R. Jacobs, R. S. Smart, P. G. Kingsmill, W. G. Beck, M. D. Guppy, J. R. Wait.

In addition to skiing, Jim was an avid runner, swimmer and bicyclist.

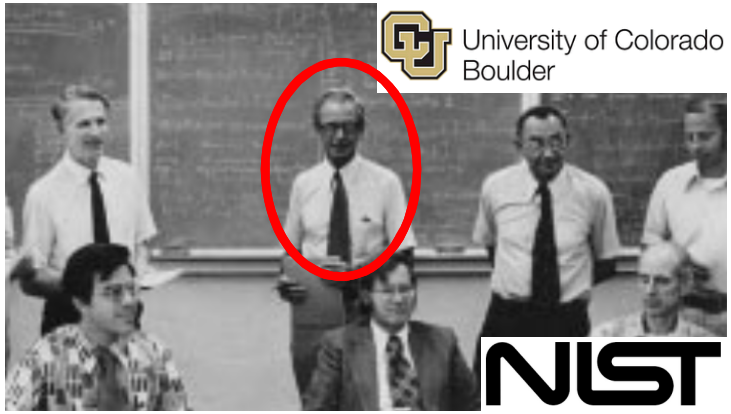
Biography: Jerome & Ottawa

- After summers in Jerome, Jim returned, upon receiving his Ph.D., to work as a Research Engineer for Newmont Engineering, continuing to pursue electromagnetic methods in geophysics and exploration and started his prolific publishing efforts.
- It was there he met and married his wife, Gertrude.

- After a little more than a year, Jim and Gertrude returned to Canada when he joined the Radio Physics Laboratory of the Defense Research Telecommunications Establishment in Ottawa in 1952.
- At this point his electromagnetics career flourished as he published numerous papers on electric and magnetic sources in the presence of the earth. Some of this work was the start of extensive work on electromagnetic fields in layered media.

Biography: Boulder

- In 1955 Jim accepted an offer from the Central Radio Propagation Laboratory (CRPL) of the National Bureau of Standards (NBS) in Boulder, Colorado where he stayed until 1980.



- He held numerous positions in the Boulder Laboratories and was a Professor Adjunct in the Electrical Engineering Department of the University of Colorado, Boulder.

- Worked on a variety of electromagnetic problems including ground wave propagation over mixed paths, pulse propagation in the earth and in the ionosphere, propagation along thin wires, and periodic structures (wire mesh shielding and propagation along leaky cables).

- Collaborated with more than 90 co-authors on over 600 journal papers during this time, and he wrote 3 books.

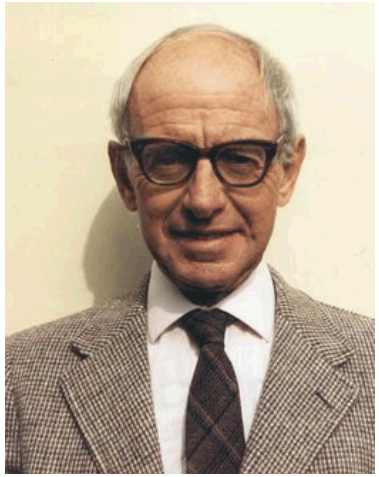
Biography: Boulder

- It is said that one of the primary reasons Jim joined the National Bureau of Standards is to take advantage of the skiing and outdoor activities in Colorado.

- He also found time to give athletic tips to novices as they arrived in Boulder from the flatlands, and share a beer or two.

Biography: Tucson

- In 1980, Jim accepted a position of Professor of Electrical Engineering, with a joint appointment in Geosciences, at the University of Arizona in Tucson.
- During this period, he was instrumental in the growth of the Electromagnetics Laboratory,
  - advised numerous M.S. and Ph.D. students
  - continued to publish (although at a slower rate than before because he was highly dedicated to the teaching process)
  - published 6 books in the areas of geo-electromagnetism, electromagnetic theory, wave propagation, and antennas.



THE UNIVERSITY OF ARIZONA

Biography: Tucson

- In addition, Jim was also very 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
  - the coupling of lightning induced EMP to power lines.
- He was the first of five to be appointed to new rank of UA Regents Professor in 1988.
- In 1989, he retired from the University of Arizona to become a private consultant, specializing in electromagnetic methods and their use in subsurface probing.
- Jim Wait passed away on October 1, 1998 at the age of 74.

Scholarship: Overview

- Made contributions in the following areas:
  - Geophysical prospecting and induced polarization
  - Scattering from cylindrical and spherical objects
  - Mathematical methods in wave propagation
  - Stratified media
  - Ionospheric, tropospheric, and ground-wave propagation
  - Mixed-path propagation and non-uniform 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 electrodynamics

Scholarship: Methodology

- Develop an appropriate model consisting of objects associated with separable coordinate systems (e.g., points, lines, planes, cylinders, spheres, etc.)
- Postulate the electromagnetic solution, effect, or property prior to writing the first equation
- Develop a formal mathematical solution using Fourier, ray, mode-matching, image, etc. techniques
- Reformulate the solution to make manifest the key electromagnetic properties or effects using asymptotic, contour deformation, series expansion, etc. techniques
- He was a masterful mathematician with an intuitive understanding of the physics associated with practical problems
- His intuition guided his mathematics; his mathematics guided his intuition
- Computation was used to confirm his solutions, but the computer was never used as a substitute for rigorous analysis. (His students never witnessed J.R. Wait in a front of a computer!)

Scholarship: Thin Wires

Fascinated with the electromagnetic properties of wires:

- Seminal Work: Developed the rigorous solution and description of the quasi-TEM “Carson mode” along a thin wire above a lossy half-space using a mixed-potential formulation
- Used the wire to study the excitation and spatial spectrum of surface waves, lateral waves, guided waves, radiation waves, etc.
- Described the propagation, dissipation, dispersion, and cut-off effects along wires in tunnels
- Quantified the reflection and shielding properties of wire grids above stratified media using Floquet-Fourier periodic expansions

Service

- Even with such a prodigious output of scholarly work, J.R. Wait was not a recluse or hermit confined to his study
- J.R. Wait was highly social and committed to the electromagnetic community of scholars:
  - Active member of URSI and served as Secretary of the U.S. National Committee and chaired the Technical Program Committee for the USNC/URSI-IEEE National Radio Science Meeting in 1976–1978.
  - Delegate to seven URSI General Assemblies.
  - Editorship of the NBS Journal of Research Part D, Radio Propagation, which led to the formation of the journal Radio Science and served as it's first editor for three terms.
  - Active in the IRE/IEEE. Organized and chaired local chapters of several IEEE Societies.

Service

- Additional editorial duties include:
  - Advisory board for URSI's Radio Science Bulletin
  - Served as U.S. coeditor for the Pergamon Press Monograph Series on Electromagnetic Waves
  - Co-editor of the Institution of Electrical Engineers (UK) Electromagnetic Wave Series
  - Editorial board of Pure and Applied Geophysics (Zurich).
  - Three terms as associate editor of the *Journal of Geophysical Research.*
- Senior scientist at the National Oceanic and Atmospheric Administration.
- Founding member and Fellow of the Cooperative Institute for Research in Environmental Sciences.
- In addition, he constantly visited and consulted with institutes, labs, and universities around the world.

Achievements: Awards and Honors

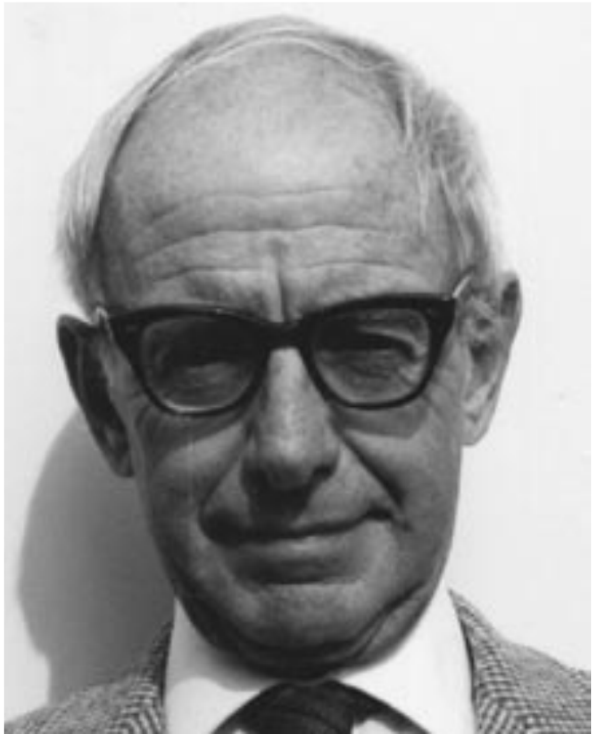
- 1958-Department of Commerce Gold Medal
- 1962-Fellow of the IRE
- 1964-IEEE Harry Diamond Award
- 1977-Elected to National Academy of Engineering
- 1977-Fellow, Institution of Electrical Engineers (U.K.)
- 1978-URSI Balthasar van der Pol Gold Medal
- 1983-IEEE Electromagnetic Compatibility Society Founders Award
- 1990- IEEE Antennas and Propagation Society Distinguished Achievement Award
- 1992-IEEE Heinrich Hertz Medal
- 1993 Honorable Membership Award of the Society of Exploration Geophysicists

National Academy of Engineering Citation:

"*Contributions to electromagnetic propagation engineering as it affects communication and geophysical exploration.*"

Legacy: Scholarly Output

- Pioneer in electromagnetic methods in geophysical exploration and wave propagation.
  - Published over 860 journal papers (using a typewriter!)
  - Wrote 8 books on electromagnetics
- His works on stratified media, propagation along thin wires, induced polarization, and wave propagation are seminal and widely cited throughout the world to this very day.



Legacy: His Colleagues

- Jim Wait was a true scholar and gentleman. He cared about individuals and was always there to lend help and encouragement.
- Anyone with a passion for electromagnetic waves was a colleague of J. R. Wait, including young professionals
- He actively solicited and encouraged collaboration with young researchers, often presenting them with some analysis he had done and asking them to participate in it's development.
- The practical application of his ideas motivated much of his work, and this appealed greatly to young engineers.
- He was generous with his praise, but never faked it.
- His work ethic and productivity was inspirational, even if impossible to achieve.

Legacy: His Students

- Academics was his second career, but J.R. Wait was an educator at heart throughout his life
- He demanded excellence and commitment from his students
- He taught students how to be effective writers of scholarly works
- His students were frequent guests in his home
- J.R. Wait set the quintessential scholar and gentleman who set the example for any of his students who wished to follow in his footsteps
- He was industrious, humble, and well-rounded. (Many of his students were clueless of his achievements.)

Closing Remarks

- Like so many others, Jim Wait taught and mentored the co-authors of this presentation.
- We consider our relationship with him to be one of the blessing in our lives, and will be forever thankful to have known him.

And of course, his dog was named “Maxwell.”