

Ballam was an unusually effective director of SLAC's research. He established a first-rate computation department and his counsel on computation in high-energy physics was widely sought. As chairman of a subcommittee of the Department of Energy's High Energy Physics Advisory Panel, he was responsible for developing projections of the nation's computing needs for high-energy physics. He also advised Fermilab on upgrading computational facilities and counseled on computation at the proposed Superconducting Super Collider. After retiring in 1982, Ballam served as an adviser to the director of SLAC.

Joe Ballam had a rare and wonderful gift for gaining the respect, admiration and warm affection of his colleagues, even while making the necessary tough decisions as an associate director. His success lay in his ability to act decisively while remaining kind, patient and understanding under great pressure—and never sacrificing his sense of justice and fairness. His contributions will be long remembered and his many friends and associates miss him deeply.

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Joseph Walter Mather

On the evening of 5 November 1996, the noted experimental plasma physicist Joseph Walter Mather died at his home in Los Lunas, New Mexico, at the age of 76.

Born in Hartford, Connecticut, Joe had completed two years of junior college when the US entered World War II late in 1941. He joined the US Army and, after basic training, was sent to New York University for a year of further study. The Army Corps of Engineers then assigned Joe to Oak Ridge, Tennessee, to work on the thermal diffusion process for separating uranium-235 as part of the Manhattan Project. In 1943, Joe was transferred to Los Alamos, New Mexico, where he was assigned to the project's electronics group.

Following his military service, Joe earned a BS degree in physics from Rensselaer Polytechnic Institute in 1948 and a PhD in nuclear physics from the Berkeley campus of the University of California in 1952. Returning to Los Alamos, Joe joined the Controlled Thermonuclear Fusion Research (CTR) program, where he worked with John Marshall, among others. Joe's early contribution was the design and building of a 100 kV linear pinch device known as Columbus II, which led to the eventual build-

ing of the 5-megajoule Scyllac facility.

In 1963, Joe and Marshall were working on a plasma gun concept, dubbed the Marshall gun, in Jim Tuck's group. The idea was to launch a high-temperature, high-density plasma into a stabilizing and confining magnetic field. The coaxial device used an annular puff of deuterium midway along the center electrode to form the initial current path upon application of the fast capacitor bank voltage. Neutron and x-ray detectors monitored the plasmas continuously. The puff valve leaked one day and filled the vacuum chamber with deuterium gas at a low pressure. When the capacitor bank fired, a pinched, high-density plasma formed off the end of the center electrode and the radiation monitors went off-scale! Thus the device now known as the dense plasma focus, or DPF (and sometimes as the Mather gun), was born. The discovery with a different geometry was made nearly simultaneously and independently by Nikolai V. Filippov of the USSR, whom Joe met much later.

On 17 June 1965, while still in the CTR program, Joe planned and carefully executed a DPF experiment for the production of 14 MeV neutrons from a deuterium-tritium mixture at a rate of 80 to 100 times the production of neutrons from the pure deuterium gas discharges. That was most likely the world's first controlled D-T fusion reaction. A separate group, P-7, was formed on 1 July 1966 under sponsorship of the Department of Defense's Defense Atomic Support Agency (DASA), to study the production of soft x rays from the high-density, high-temperature plasmas. Art Williams and Glen Livermore joined Joe in forming this new group, which left the fold of the CTR program and became a part of the physics division at what is now Los Alamos National Laboratory (LANL).

The group's first device, DPF-1, was an 18 kJ device with six capacitors and six vacuum switches. Continuous improvements through several versions led to a 1 MJ system, DPF-6 1/2, which produced 2×10^{12} neutrons per discharge from 720 kJ and a 3.2 megamp peak current. The DPF program at LANL ended in 1974, when the Pentagon stopped funding it in favor of a competing technology, though DPF technology continues to be of great interest worldwide.

From the mid-1960s to the mid-1970s, Joe's P-7 group made many significant contributions to the field of pulsed power and pinched plasma technology and to the development of high-voltage technologies.

When he left LANL in 1975, Joe had his first bypass surgery. But he



JOSEPH WALTER MATHER

recovered fully and went on to build his own home, first in Taos and then in Los Lunas, New Mexico, to be a little closer to his cardiologist. He joined the University of New Mexico in 1981 as a research professor in the department of chemical and nuclear engineering and later in the department of physics and astronomy, where he mentored graduate students in conducting hands-on research.

Bothered by the fact that the pinches in DPF are notoriously less reproducible at different locations, Joe teamed up with Harjit Ahluwalia to try to find the answer. They concluded that the geomagnetic field possibly plays an important role in the problem, which still has not been appreciated by the plasma physics community.

Joe loved science, especially plasma physics, with the same passion that he hated war and the development of nuclear arsenals. Throughout his life, he served both causes with a deep sense of urgency and compassion. Those of us whose lives were enriched by the experience of interacting with him miss him and will remember this humane man for the rest of our lives.

HARJIT S. AHLUWALIA

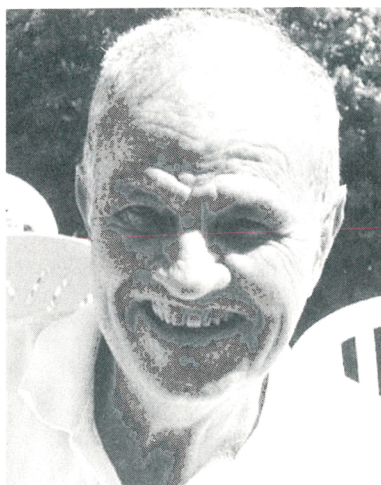
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Earl Wadsworth McDaniel

Earl Wadsworth McDaniel, a pioneer in atomic collision physics and gaseous electronics, died in Atlanta on 4 May 1997 of a brain aneurysm. His influence will be felt for many years through his seminal research contribu-



EARL WADSWORTH MCDANIEL

tions, which delved deeply into the microscopic behavior of ionized gases, his numerous scholarly monographs and the prominent scientists he trained.

Earl was born in Macon, Georgia, on 26 April 1926. He received his BS in physics from the Georgia Institute of Technology in 1948 and his PhD in physics in 1954 from the University of Michigan, where he specialized in radiocarbon dating. In 1954, he joined the physics faculty at Georgia Tech, where he became a professor of both physics and electrical engineering. In 1970, he was awarded the title of Regents' Professor, a post he held as an emeritus until his death.

Earl's long and prolific research career was outstanding in its originality and ingenuity. He developed one of the first crossed-beam experiments for the study of ionization and excitation in electron-ion collisions. And as leader of a large group of researchers, he spearheaded the measurement of heavy particle ionization cross sections at energies to the MeV region.

However, the real scientific passion of Earl's life was studying the transport properties of gaseous ions at very low energies. His work on ion mobilities, diffusion coefficients and ion-molecule reactions has left an immense legacy to the field. By applying mass spectrometry to drift tube studies, Earl opened a new era in the study of ionized gases. His careful and meticulous measurements set a high standard for the field and so greatly enriched our scientific knowledge of ion transport mobilities, longitudinal and transverse diffusion coefficients and the rates of ion-molecule reactions. As such, they provided the main impetus for the development of increasingly sophisticated theories of the motion of ions in the presence of neutral scatterers.

Ed Mason once remarked that the field of ion transport falls into two categories, the dinosaur age of "Before Earl" and the modern era of "After Earl." Indeed, the paper Earl wrote in 1968 with Dan Albritton, Tim Miller and David Martin, "Mobilities of Mass Identified H_3^+ and H^+ Ions in Hydrogen" (*Physical Review*, volume 171, page 94), was among the 100 included in the celebratory compendium *The Physical Review—The First Hundred Years: A Selection of Seminal Papers and Commentaries* (AIP Press, 1995).

Earl served as the doctoral adviser to many graduate students, who have gone on to follow successful and productive careers, with some reaching the highest ranks of the scientific community.

In addition to his numerous scientific research papers, Earl wrote or cowrote six books on atomic collisions and coedited nine other books dealing with the subject. His classic monograph *Collision Phenomena in Ionized Gases* (John Wiley, 1964) was considered the preeminent text in the field for many years and served as an inspiration for many who studied heavy particle scattering dynamics. Most recently, Earl updated his earlier work to produce a widely acclaimed succession of monographs.

Earl was much more than an outstanding physicist. He was larger than life in everything he did. He possessed a lively intellect and was a widely read scholar who pursued knowledge with the same verve and love that he showed for physics. He was an expert on the history of the great military conflicts, enjoyed fiction, was well versed in the classics and loved music. He enhanced our lives by embodying the highest goals to which we can aspire. Those who knew him will long remember his high scientific standards, exemplary integrity, convivial personality and occasionally outrageous sense of humor. We will miss his warmly given advice, loyal friendship and, most of all, his generously shared understanding of and zest for life.

JAMES GOLE
EDWARD THOMAS
TURDAY UZER

Georgia Institute of Technology
Atlanta, Georgia

Mark Aaron Samuel

Mark Aaron Samuel, a professor of physics at Oklahoma State University (OSU), died suddenly on 7 November 1997. He was 53.

Mark was born in Montreal. After obtaining BS and MS degrees at McGill University, he worked on finite quan-

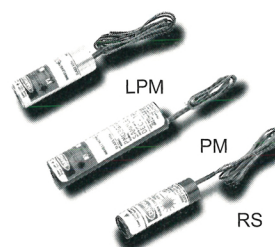
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