by nature's secrets and eager for human welfare the world around.

BRUCE DAYTON
Carmel Valley, California
DEVENDRA LAL
University of California, San Diego
La Jolla, California
NIELS LUND
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Danish Space Research Institute
Lyngby, Denmark
PHILIP MORRISON
Massachusetts Institute of Technology
Cambridge, Massachusetts

Phyllis S. Freier

Phyllis St. Cyr Freier died at home on 18 December 1992 after a long struggle with Parkinson's disease.

Phyllis had a long and fruitful association with the University of Minnesota. She received her BS from the university in 1942, her MA in 1944 and, after a stint at the Naval Ordnance Laboratory from 1944 to 1947, her PhD in physics in 1950. She remained at the university after graduation. Her thesis was based on the discovery she and her colleagues made of the presence of heavy nuclei in cosmic radiation. This demonstration of the close relation between ordinary matter and that in the cosmic radiation remains one of the key discoveries in astrophysics. It solved many of the problems vexing cosmic-ray physics at the time.

Phyllis went on to establish an international reputation as a cosmic-ray physicist and as an expert on the application of nuclear emulsions to a diversity of problems in astrophysics and physics. She and her colleagues studied the nature and composition of the primary cosmic radiation, looked for high-energy gamma-ray sources and investigated the production of energetic solar particles and the effects of solar modulation on the primary radiation. In later years she used emulsions to investigate the phenomena that occur during the interactions of relativistic heavy nuclei with other heavy target nuclei. She continued to display a keen interest in these topics until the day of her death.

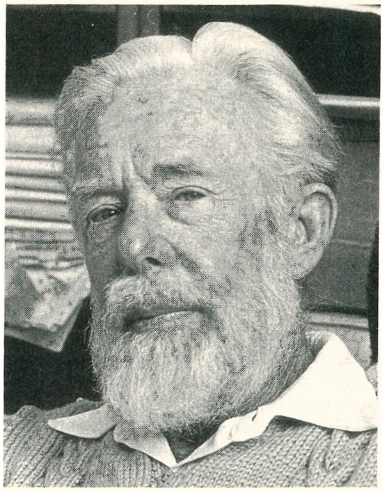
Phyllis played an important role in the physics community, serving on both APS and NASA committees and as an APS councillor. At the same time she served her university in many capacities on senate and college committees.

Phyllis proved to be an inspiring and dedicated teacher once the nepotism rules were relaxed to allow her to play such a role. (Her husband was also on the faculty.) She devoted a great deal of time and effort to her undergraduate classes; her efforts were appreciated both by the students, who typically gave her standing ovations, and by the university. Further, she was a role model and mentor to generations of graduate and undergraduate students.

Phyllis is sorely missed by her family and all who came into contact with her, especially her students, colleagues and many friends.

C. JAKE WADDINGTON
University of Minnesota, Minneapolis

Oscar Buneman



Oscar Buneman

Oscar Buneman, emeritus professor of electrical engineering at Stanford University and a contributor to plasma electrodynamics, fundamental electromagnetic theory and numerical analysis, died on 24 January 1993.

Born 28 September 1913 in Milan, Italy, Buneman was educated in Hamburg, Germany. He was imprisoned by the Nazis for political resistance, and on his release in 1935 he went to Manchester University, England for his BA and MA degrees in mathematics. At the outbreak of war in September 1939 he was interned for nine months in Canada with other foreign nationals. On returning to Manchester, Buneman completed a PhD supervised by Douglas Hartree in 1940 and then used a primitive analog computer developed at Manchester to discover the bunching of particles and the "Buneman potential" that exists in a cavity magnetron.

In 1944, as a member of the British mission to the Manhattan Project at Berkeley, Buneman worked on ion optics for the calutron isotope separation device. In 1945 he transferred to the Canadian reactor project, and from 1946 to 1950 he worked in the Atomic Energy Research Center at Harwell, England. For the next ten years, Buneman was a lecturer in mathematics at Cambridge University. From 1960 unitl 1984 Buneman was professor of electrical engineering at Stanford University.

In the 1960s Buneman, with Roger Hockney, developed a fast, direct method for solving Poisson's equation using a two-dimensional spatial grid, which made electrostatic simulation attractive and economical and eventually superseded the method of summing Coulomb interactions. These activities proved relevant to electron streaming in the magnetosphere and to the impact of the solar wind. With Ken-Ichi Nishikawa, Torsten Neubert and Dong Sheng Cai, Buneman developed TRISTAN, a three-dimensional electromagnetic particle simulation code for Cray supercomputers, which showed the dramatic kinematics of formation of the bowshock, the magnetospheric cavity, the magnetotail and other features of the magnetosphere known from observation, and that reproduced the transient behavior associated with the flapping of the solar wind sheet. Ultimately he simplified the self-consistent field approach to the point where all of the particle behavior could be deduced directly from Newton's equations of motion and Maxwell's equations without Poisson's equation or magnetohydrodynamics.

Buneman gave his courses at Stanford an inimitable mathematical and computational flavor. As the trend to improved high-level languages advanced, Buneman stressed the continued need for meticulous attention to microprogramming. The power of his TRISTAN code is a testimony to the effectiveness of combining basic knowledge of electrodynamics with an intimate understanding of machine fundamentals.

Buneman's graduate students remember the inspiration he brought to regular research discussions as well as his personal kindness. He loved the outdoors, spending as much time as possible with his family in the mountains and sun. He liked sleeping in the open (even at home, on his deck), swam regularly and, until late 1992, was a familiar sight in brief shorts and an ancient crash helmet, riding his racing bicycle to his office. He will be very much missed by his colleagues.

RONALD N. BRACEWELL
Stanford University
Stanford, California ■