developed its leadership in space science and established international cooperative programs, Schardt's responsibility was to find and support the most promising scientists in the field. In addition, he headed payload-selection committees, translating purely scientific recommendations into practical and coherent payloads and resolving unavoidable conflicts.

After 15 years of distinguished leadership at NASA Headquarters, Schardt returned to science, coming to Goddard in 1976. He began working with data obtained by Pioneers 10 and 11 during their transits through the Jovian magnetosphere. When Voyager 1 and 2 encountered Jupiter in 1979, Schardt was part of the cosmic ray science team. By the time these spacecraft encountered Saturn (1980–81), he was the leading authority on high-energy magnetospheric particles. At the time of his death he was the principal investigator on an energetic-particles experiment to be flown on the proposed NASA interplanetary spacecraft, which is part of the International Solar Terrestrial Physics program.

To those of us who worked with him, Schardt gave and taught much. His character, like his science, was solid. He accepted success and adversity with equanimity. To him the most important job was the next one waiting to be done. We shall miss him as a colleague and friend.

T. J. Birmingham
F. B. McDonald
T. G. Northrop
*NASA, Washington DC*

## Raymond C. Grimm

Raymond C. Grimm died in Sydney, Australia, on 6 August 1984, at the age of 39. He suffered a heart attack while playing in a basketball game.

Grimm was born on 10 November 1944, in Adelaide, Australia. He received his education there, earning a BSc at Adelaide University and a PhD in theoretical physics at Flinders University. After spending two and a half years in the theoretical division of the UK Atomic Energy Authority at Culham Laboratory in England, he joined the Princeton Plasma Physics Laboratory in 1972. In the latter post he served both as principal research physicist at the laboratory and professor of astrophysical sciences at the university. Grimm returned to Australia in April 1984, to organize and lead a fusion-physics program for the Australian Atomic Energy Commission Research Establishment at Lucas Heights, New South Wales. He was the first professorial fellow appointed at the University of Sydney.

Grimm's PhD thesis dealt with the development and application of Monte Carlo techniques for solving Schrödinger's equation. This pioneering work has often been cited in research papers. While at Culham, he began to study magnetohydrodynamic models of plasma confinement in toroidal systems. His quick grasp of the physical significance and usefulness of the models, coupled with his understanding of numerical analysis, computational techniques and the capability of computer hardware led to his appointment at Princeton.

Computational plasma physics emerged as a field in its own right while he was at Princeton, with Grimm being recognized as a leader in its development. Grimm was the principal architect of the Princeton Equilibrium, Stability and Transport codes that have been instrumental in designing and analyzing data from several large tokamak experiments. Outstanding characteristics of Grimm's work were his skillful combination of analytical analysis with computation and his careful validation and interpretation of results.

Apart from his technical contributions, Grimm deserves equal recognition for his administrative accomplishments. Shortly after joining the Princeton staff, he became head of the Laboratory's computer center and, in addition, served as deputy head of the theoretical division, organizing most of the work on MHD studies, modeling and computational activities. His sound judgement and technical expertise made him a valued member of several Laboratory committees and of many advisory groups for both the University and the US Department of Energy.

Probably the strongest memory Grimm leaves is his sense of personal integrity and caring. His lectures were

GRIMM

always well prepared and skillfully presented and his office door was always open to students who needed help, advice, or just wanted to chat. Many administrative duties evolved upon him because of his natural ability to work things out to everyone's satisfaction. He possessed a talent for recognizing the potential of the new young physicists at the Laboratory, and several of the staff members owe him thanks for his loyal support. He loved competitive sports, in particular basketball, and entered every game with an enthusiasm that was characteristic of his approach to life, and an aggressiveness that contrasted with his gentleness in other spheres.

An annual graduate-student prize to be awarded for significant achievement in computational physics is being established at Princeton University in memory of Raymond Grimm.

JOHN L. JOHNSON
*Princeton Plasma Physics Laboratory*
ROBERT L. DEWAR
*Australian National University, Canberra*

## Avadh Behari Bhatia

Avadh Behari Bhatia, a pioneer of electronic transport theory, died at the age of 63 on 27 September 1984. Bhatia was born in India and attended the University of Allahabad where he was awarded a BSc in 1940 and a DPhil in 1946 under the supervision of K. S. Krishnan. In 1947, Bhatia went to the University of Liverpool and received his PhD under Herbert Fröhlich. He also spent some time in the University of Bristol, where he was a research scholar with Nevil F. Mott's group. In 1952 he moved to the University of Edinburgh where he continued his research under Max Born. Bhatia came to Canada in 1953 with the award of an NRC fellowship and after staying two years in the laboratories of the National Research Council in Ottawa he accepted a position in the physics department of the University of Alberta, where he remained for the rest of his life. He became professor of physics in 1960 and for 1964–69 he was the director of the Theoretical Physics Institute.

Bhatia and Krishnan pioneered the calculation of the electronic transport properties that later formed the basis for the pseudopotential theory of electronic scattering in metals. He also contributed to the theory of diffraction of light by ultrasonic waves, and wrote a chapter on this topic in the classic *Principles of Optics* by Max Born and Emil Wolf. In the early 1970s Bhatia, with the help of a number of collaborators, started a very detailed formulation of the structure factors for multicomponent liquid alloys. This work has now become the standard in this field. In the past few years, collaborating with Norman H. March of Oxford University, he studied the surface properties of liquid alloys; this joint work has contributed in a significant way to the understanding of these alloys.

Bhatia's contributions were not limited to the physics of condensed matter and ultrasonic waves, but also included pioneering work in theoretical nuclear physics. His work on the scattering of polarized neutrons by a proton gas was done independently and at the same time as the celebrated work of Lincoln Wolfenstein. This was followed by a novel and simple explanation of the angular distribution of stripping reactions, which he did in collaboration with his colleagues at the University of Liverpool. Later, in Alberta, working with Parkash C. Sood and Lynne Trainor he proposed an alternative method to the Fermi gas model of nuclear matter, by applying the Wigner–Seitz theory to a quasilattice model of nuclear matter. In addition to writing a chapter in the *Principle of Optics*, Bhatia assisted Born in revising his other well-known treatise *Dynamical Theory of Crystal Lattices*, which Born wrote with Kerson Huang. His own book *Ultrasonic Absorption* (Oxford U.P., 1967) is an astute authoritative exposition of every aspect of the theory and a cornerstone for anyone who may wish to study this subject. A second book, written with Ram N. Singh and based on Bhatia's lectures on the mechanics of deformable media, is nearly complete and will be published posthumously. The Fifth International Conference on Liquids and Amorphous Metals in 1983 was dedicated to four distinguished scientists: Pol Edgard Duwez, Nevil F. Mott, David Turnbull and Bhatia, whose work was cited as a significant contribution in this field.

BHATIA