Southern Colorado), for her studies in the history of physics and for her activism toward removing barriers that have kept women and minority group members from choosing careers in science and engineering.

LUNINE RECEIVES UREY PRIZE FOR PLANETARY SCIENCE

In November the division for planetary sciences of the American Astronomical Society presented its 1988 Harold C. Urey Prize to Jonathan I. Lunine (University of Arizona). The prize, which is given each year to recognize and encourage outstanding achievement in planetary research by a young scientist, honors Lunine's "insightful and creative work on the nature and role of ices and volatiles in the solar system" and his "innovative chemical and thermal model for the atmospheres of 'brown dwarfs.' "

Lunine's research has focused on developing thermodynamic and chemical models of the origin, evolution and present states of comets and of the icy satellites that orbit the outer planets. Using data from the European Giotto and Soviet Vega spacecraft on the volatile composition of Comet Halley, Lunine is trying to determine the conditions under which it formed.

Volatiles, abundant compounds that undergo phase changes over the temperature ranges typical of their surroundings, mediate mass and energy exchange among the atmosphere, the surface and the interior. Water and carbon dioxide are the dominant volatiles on Earth; ammonia, methane, carbon monoxide and nitrogen play similar roles on comets and cold satellites.

Volatile molecules provide information on the histories of icy satellites, because volatiles are released from the satellites' deep interiors through volcanic outgassing. On Earth, early epochs of volcanism may have driven water, carbon dioxide and other volatiles to the surface and atmosphere. "On large icy satellites," Lunine explains, "early volcanic activity involving water–ammonia fluids probably brought large quantities of methane, carbon monoxide and other volatiles to those surfaces."

Lunine also models "brown dwarfs," which are hydrogen–helium objects not massive enough to ignite hydrogen fusion. Brown dwarfs are expected to be extremely faint, and so far none have been definitively observed.

Lunine received a BS in physics and astronomy from the University of Rochester in 1980, and a PhD in planetary sciences from Caltech in 1985. He joined the Lunar and Planetary Laboratory of the University of Arizona as a research associate in 1984. He is now an assistant professor in the department of planetary sciences.

IN BRIEF

Roberto Peccei, formerly head of the theory group at DESY in Hamburg, FRG, has become a professor of physics at UCLA.

Eric D'Hoker, formerly an associate professor of physics at Princeton University, has become a tenured associate professor of physics at UCLA.

Katsushi Arisaka, formerly a research investigator at the University of Pennsylvania, has become an assistant professor of physics at UCLA.

Alan Lightman, formerly a staff member at the Harvard–Smithsonian Center for Astrophysics, has been appointed professor of science and writing at MIT, teaching in the departments of physics and humanities.

OBITUARIES

George McVittie

George Cunliffe McVittie, long-term head and founder of the modern department of astronomy of the University of Illinois at Urbana–Champaign, died in England on 8 March 1988. He was 83.

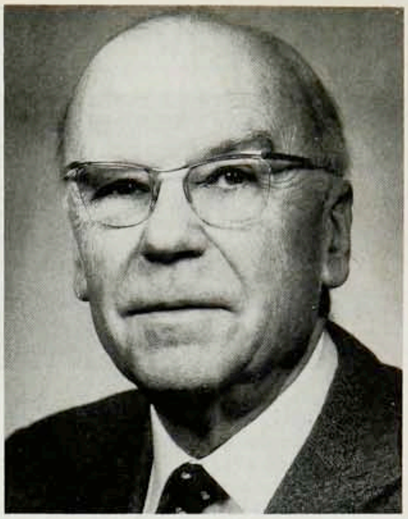
McVittie came to Illinois in 1952 to rejuvenate the astronomy program, whose only professor, Robert H. Baker, had recently retired. He found a "department" with no staff other than himself, with a few antique instruments and with no students. He left it in 1972 with a staff of nine senior faculty members, world-class radio and optical telescopes, two dozen PhD students in progress, and a growing reputation in research. The department has since built on this momentum to become one of the country's leading academic astronomy departments.

McVittie was born in Turkey in 1904 of a British family of merchants and diplomats, and was raised in Smyrna (now Izmir) until the age of 18. He never attended school, but was taught by private governesses and tutors in French, English, modern and ancient Greek, ancient history and mathematics. He passed the Cambridge University examinations with distinction in 1921 and entered Edinburgh University in 1922 when his parents returned permanently to England. In 1927 he was awarded an MA in mathematics and natural philosophy, having studied with such famous teachers as the mathematician Edmund T. Whittaker, the physicist Charles G. Darwin and the philosopher Norman Kemp Smith. After two additional postgraduate years teaching and conducting research at Edinburgh, he entered Cambridge to study under Arthur S. Eddington. In 1930 McVittie was awarded a PhD for his thesis on unified field theories. There followed brief teaching appointments at the Universities of Leeds, Edinburgh and Liverpool, and then a permanent appointment as reader in mathematics in King's College, University of London, in 1936.

In 1939, with the outbreak of World War II, he entered civilian service with the military agency concerned with cryptanalysis; there he became a central participant in the interception of meteorological data from enemy sources. This duty required him to study atmospheric dynamics as well as cryptanalysis, and led to his lasting interest in gas dynamics. For this wartime service he was honored by appointment as Officer of the Order of the British Empire. He returned to King's College in 1945, where he remained until his appointment as professor of mathematics and head of the department at Queen Mary College, University of London, in 1948.

McVittie and his wife became acquainted with American university life in 1950, while he was on a short lectureship at Harvard. In early 1951 President George D. Stoddard of the University of Illinois inquired of Harlow Shapley, director of the Harvard College Observatory, whether he thought the defunct Illinois astronomy department should be revived, and who might undertake the job. Shapley recommended McVittie; he thought a department in the observationally less-than-benign meteorological conditions of the Midwest might best be led by a theoretical astronomer. Though McVittie had never had a strictly astronomical post, he had become known for his mathematical studies of the structure of the universe. Thus he came to Urbana in the fall of 1952.

McVittie's contributions to astronomy lie principally in theoretical astrophysics, with particular empha-



George McVittie

sis on general relativity and cosmology. Although often heavily mathematical in nature, his work never lost sight of the importance of observations, and was, in fact, often devoted to the very question of how best to make contact between theory and observational data. Indeed, he was a pioneer in the development of many methods still used today to make theoretical sense of observations (and vice versa). In his years at Urbana there was constant activity in the design of novel radio and optical instruments, and faculty members participated in the planning, design and establishment of major instruments at the national observatories.

In his PhD thesis McVittie was able to solve the Maxwell–Einstein equations for a particular case, and to find the corresponding solutions for three unified field theories. The results were unfavorable toward the unified theories, and left McVittie with a skeptical attitude toward unified field theories in general; indeed, a fully satisfactory unification of electromagnetism and gravity eludes us to this day.

During the 1930s, Edward A. Milne's "kinematical relativity" was being advanced as an alternative to general relativity. McVittie showed that gravitational accelerations could not be incorporated into kinematical relativity, and that a strict axiomatic formulation of the theory indicated that it did not necessarily have any connections with cosmology. This work impressed upon him the difficulties associated with the apparently simple notion of distance in general relativity and led him to reanalyze that problem in depth many years later.

A recurrent theme in McVittie's research was obtaining spherically symmetric solutions of Einstein's equations for perfect fluids (including radiation such as the cosmic microwave background radiation). The work climaxed in an exact solution for a massive "particle" immersed in an ambient fluid, which at large distances modeled an expanding universe. At the time there seemed to be no astronomical motivation for this work, which he abandoned until the 1960s, when the study of highly collapsed objects assumed importance with the emergence of the concepts of black holes and neutron stars. In later work McVittie also analyzed the collapse, expansion and oscillation of self-gravitating (relativistic) fluid spheres.

But his most important work may well be on cosmology. McVittie was renowned for his meticulous and insightful comparisons of observational data with (uniform) model universes. Starting with Edwin Hubble's galaxy-count data from the 1930s, McVittie showed that Hubble's method implied using more than one "kind" of distance for galaxies of a given apparent magnitude. He was able to prove that the use of such empirical distances was unnecessary, and could in fact unnecessarily restrict the range of acceptable model universes. Furthermore he strongly emphasized the need to use formulas that connected observables, and made a masterly exposition of this approach (the acknowledged standard today) in his well-known book *General Relativity and Cosmology*.

As time went by and the quantity and accuracy of the data improved, McVittie remained interested in the interpretation of magnitude-versus-redshift data for clusters of galaxies. His chief concern was to determine the value of the cosmological deceleration parameter. Early work suggested a slowing of the expansion with time, and this was supported by a rigorous analysis of much more extensive data in the 1970s. In parallel with this work McVittie made an attempt, in the 1950s, to fit a suitable model universe to counts of extragalactic radio sources. This project provided motivation for the establishment of the Vermilion River Observatory of the University of Illinois, which was used to make just such counts. A penetrating analysis led McVittie to the important conclusion that changes "in the radiative power or the number density of sources have occurred" over time and that therefore "counts of these objects provided no criterion by which to select the model of the observed universe." At the time that must have been a

discouraging conclusion, but we know today that it was certainly correct. As we look out in distance, hence back in time, we see galaxies at ever younger phases of their evolution, at stages where their radiant outputs are quite different from what they are today. Likewise, as we sample a larger volume of space we more readily find extreme objects: first active galaxies, then quasars, which can be enormously brighter at radio wavelengths than "ordinary" galaxies like those we find in our neighborhood today.

McVittie had many other interests in astronomy and theoretical physics, but it is impossible to do them all justice in this limited space. Suffice it to say that his work was always finely crafted, incisive and significant, and was characterized by his insistence that theory should relate directly to observations.

He was a man of acerbic wit and firmly held opinions, who enlivened the Urbana academic senate and professional society meetings with pithy comments on the foibles of the institutions and their constituents. He was much loved by close friends and colleagues, and was respected by his peers, whatever their views on scientific or academic matters.

Following his retirement from Illinois in 1972, McVittie moved to Canterbury, England, where he became honorary professor of theoretical astronomy at the University of Kent. There he continued to teach, supervise PhD theses and publish theoretical studies until the age of 82.

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The writer acknowledges the essential collaboration of Dimitri M. Mihalas, the current (and first) incumbent of the McVittie Professorship at the University of Illinois.

G. W. Swenson Jr
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Ernest W. Salmi

Ernest W. Salmi died 5 October 1987 in Albuquerque, New Mexico, at the age of 64. He was born in Detroit and served with the US Army in the South Pacific Theatre during World War II.

Salmi completed his undergraduate studies at Wayne State University in 1946 and received his PhD from the University of Michigan in 1950. He spent all of his professional career at the Los Alamos National Laboratory except for one year (1963) at the Joint Center for Research (EURATOM) in Ispra, Italy.

When Salmi arrived at Los Alamos in 1950, he found himself in a theoretical nuclear weapons design group. Neither this nor other groups had what could have been considered a workable and rigorous technique for designing nuclear explosive devices or for analyzing expensive experiments. Salmi set himself the task of improving, generalizing and making more rigorous the existing computational scheme for integrating the coupled neutron-dynamic and energy generation equations in time and space for an exploding nuclear device. This effort was impressively successful, especially considering the card-programmed computers of that era. Salmi created one of the first large computer programs of this type to work consistently and reproducibly. The formulation he created was used widely in its original application and for solving many other physical problems.

In 1958 Salmi was appointed alternate group leader of the advanced concepts group in the Rover (nuclear rocket) division. He was a coinventor of the cesium-diode thermionic cell for directly converting heat to electricity. He directed studies of low-thrust interplanetary orbits and developed criteria for electric-power-to-weight ratios essential to high performance in orbit-to-orbit transfer systems.

Salmi had wide interests that ranged from heat pipe applications for energy recovery and for spacecraft radiator systems to fusion and fission research. In the late 1960s the problem of radar clutter from nuclear explosions caught his attention, and he postulated that some important effects could be explained by metal loading of the atmosphere. To prove this point, he used radar to look at various metal-loaded high explosives being detonated above the ground. One of his experimental projects in fusion research was to tailor the pulse of current from an explosive-driven flux compression generator to drive a Z-pinch. These experiments were terminated, however, before the feasibility of the concept could be determined.

In 1982 Salmi turned his attention to the effects of nuclear weapons on other nuclear warheads, and in the following years he made significant contributions to a feasibility study of the Navy's nuclear options. He was concerned about international arms control and helped organize the Los Alamos Committee on Arms Control and International Security.

After bouts with aplastic anemia and a lower-back spinal problem, he took medical retirement in 1986. He continued to consult for Los Alamos until stricken by lung cancer. He will be remembered by his colleagues for his impatience with concepts that he