Obituaries

Prepared by the Historical Astronomy Division

DAVID FULMER BENDER, 1913-2004

David Fulmer Bender died in San Diego, California, on 13 September 2004, at the age of 91. His heart stopped suddenly while he was dancing. His pioneering work in establishing comprehensive, computer-accessible ephemerides of asteroids and comets found many applications, including the first- ever visit to an asteroid, Gaspra, by an interplanetary spacecraft.

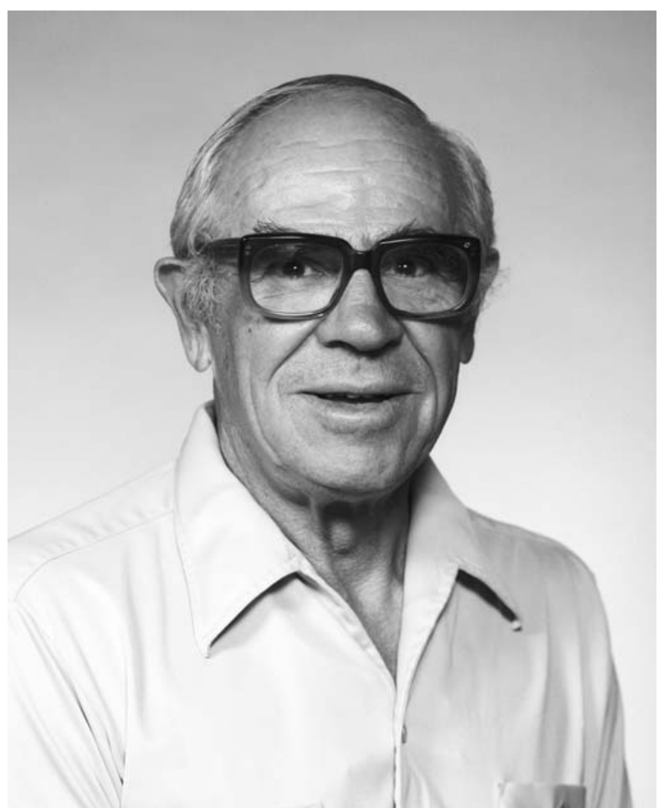
Dave was born in Reno, Nevada, on 10 February 1913, to Homer Charles Bender and Susan Bowers Bender. The family moved to Spokane, Washington, while Dave was very young. His father was a civil engineer and a graduate of MIT, who helped design bridges and dams throughout the Northwest, including the Grand Coolie Dam. Dave had a brother, Phillip (now deceased), who was one year younger.

Advancing rapidly in the Spokane school system, Dave finished high school when he was 15 years old. At 16 he moved to Pasadena, California, and began his studies at the California Institute of Technology (Caltech). In addition to pursuing his course work, he was active in track and football, a tendency toward physical exercise that stayed with him for the rest of his life. It was probably during these years that Dave heard a lecture by Albert Einstein, as mentioned to colleagues many years later. Dave received a BS degree in physics in 1933, an MS in 1934, and a PhD in 1937, all from Caltech. His dissertation was entitled, ''The Index of Refraction of Air in the Photographic Infrared.'' During his sophomore year he found his way to Pomona College in Claremont, California, where he met his future wife, Elizabeth Boyden at a social gathering. They were married in 1935.

Dave's academic career spanned the years from 1937 to 1970, initially at Louisiana State University, Vanderbilt University, and then Fisk. As a life-long pacifist and conscientious objector, Dave served alternate duty during World War II. In 1946 he joined the faculty of the physics department at Whittier College in California, where he became the department chair and remained until 1970. Here Dave's strong personal interest in the students became evident. During each year's spring break, he and Beth led a car caravan of interested astronomy and physics students to Death Valley for primitive camping, exploring the desert, studying the stars, and shooting off rockets. Beth organized all the food and Dave cooked the breakfasts, with French toast being his specialty. This tradition was so popular that many students returned year after year, long after having left the college. Dave enjoyed leading the astronomy club at Whittier College, and also participated in a municipal astronomy club.

In the sixties, in addition to his job at the college, Dave worked part time at the Space Science Laboratory of North American Aviation (later North American Rockwell and now Boeing). Dave co- authored, with Gary Mc Cue and others, several papers on orbital rendezvous techniques, a capability of prime interest to the Apollo program. Soon apparent, however, was Dave's interest in the hundreds of asteroids whose orbits were known at the time. In his spare time he punched their orbital elements into computer cards and initiated a long career of searching for opportunities for spacecraft to flyby or rendezvous with one of these minor planets. He learned enough Russian to read books important at the time on the subject of asteroid orbits. In 1966 he had enough data to publish a paper on some possible asteroid encounters by human missions to Mars. Through conferences of the American Astronautical Society, Dave became acquainted with Roger Bourke, the group supervisor of the Advanced Projects Group at the Jet Propulsion Laboratory (JPL), which is managed by Caltech for NASA. In 1970, Dave retired from Whittier College and began working full time for Roger at JPL.

JPL was still working on missions to the inner planets and was starting to develop missions to the outer planets. Roger understood the potential of having Dave pursue his interest in the small bodies and of having him create a comprehensive set of ephemerides that would be available for the Advanced Projects Group to use for mission planning purposes. Dave worked with Phil Roberts, Carl Sauer, and others who were creating mission design software at the time to ensure that the asteroid file would be compatible with these computer programs. Dave, himself, authored many papers documenting trajectories he discovered to various asteroids, comets, and Lagrange points, along with the search techniques he used. He also documented surveys of opportunities, some for use with low-thrust propulsion as well as the more common



David Bender

chemical propulsion. Along with Raymond Jurgens, Dave published opportunities for radar astronomers to view asteroids passing close to the Earth. Dave did not restrict his investigations to small bodies. He also published papers on Venus missions, lunar swingby techniques, Jupiter gravity assist trajectories to Kuiper belt objects, and multibody-assist trajectories for missions to Jupiter's satellite Europa (the latter two in the 1990s!).

Brian Marsden recalls that in1980 Dave visited him at the new facilities of the Minor Planet Center in Massachusetts and left with a box of new computer cards punched with the orbital elements of the 2000 asteroids known at that time. Colleagues at JPL remember how excited he was when he returned from that trip. As more asteroids were discovered, he would add their orbital elements to the file. Because of Dave's pioneering work in making the asteroid orbits accessible for mission studies before most people cared about these bodies, he can be credited in part for the mission Galileo's close flyby of both Gaspra (in 1991) and Ida (in 1993), along with the discovery of Dactyl, the first confirmed asteroid satellite. Dave eventually passed the responsibility of maintaining the small body file to Donald Yeomans and Ravenel (Ray) Wimberly at JPL. Now called DASTCOM, it includes elements for over 260,000 bodies, most of them asteroids.

Dave retired from JPL in 1987. At a party in his honor, Eleanor Helin, a JPL colleague and persistent asteroid hunter, announced that an asteroid that she and, then student, Schelte (Bobby) Bus, had discovered in 1978 at Palomar would henceforth bear Dave's name.

Dave was devoted to Beth. They participated in many activities together that strengthened their relationship. He wrote her love poems, sometimes quoting from *The Prophet* by Kahlil Gibran. Beth passed away in 1990. Dave lived another fourteen years, continuing an active life. He is survived by his son and daughter-in-law, Robert and Leta Bender of Jamul, California, his daughter, Susan Rodrigues, of Tucson, Arizona, and three grandchildren.

Dave is remembered as a visionary, whose enthusiasm for space mission design was unstoppable; as someone who was still jogging and playing softball in his seventies; as a modest, kind, and generous human being; and as a caregiver who genuinely believed that the most important thing in life is love.

How fitting it would be for a space vehicle to visit asteroid ''2725 David Bender'' one day. How pleased the mission planners would be to find in their research that the namesake of the object of their interest was a pioneer in their field of endeavor.

Sylvia L. Miller
Jet Propulsion Laboratory

JOSEPH WYAN CHAMBERLAIN, 1928 – 2004.

Joseph W. Chamberlain died at home with his family on April 14 2004 after a long illness. He was born August 24, 1928 and raised in Boonville, Missouri, where his father was the doctor. There was no doubt that both Joe and his elder brother Gilbert would also become doctors, but Joe's first class in comparative anatomy at the University of Missouri convinced him that this was not his destiny and he immediately switched to physics and astronomy. He obtained a Masters degree in physics and moved on to the University of Michigan; his advisor was Lawrence Aller and he was also strongly influenced by Leo Goldberg. Early in 1952 he was awarded a PhD and began work at the Air Force Cambridge Research Center where he changed his interests to the upper atmosphere. Among his duties was liaison with research groups at several universities, and I met him when he visited us at the University of Saskatchewan one very cold winter day. He was soon posted to work with Aden Meinel at Yerkes Observatory, where he was added to the faculty and became the leader of the group when Meinel departed to organize the Kitt Peak National Observatory. He himself moved there in 1962 as Associate Director for Space Science; the name of the division was later changed to Planetary Science. He recruited a strong group to work on planetary atmospheres and several group members played important roles in the Mariner 10, Pioneer Venus, Viking, Voyager and Galileo missions. He was elected to the National Academy of Sciences in 1965.

Joseph Chamberlain

As leader of the group he recruited at Kitt Peak, Joe earned the admiration and loyalty of us all. He strongly preferred doing science to his administrative tasks, but he was still effective at the latter. He was considerably bothered that his superiors, especially the managing boards with which he had to deal, did not always meet his high standards. Joe's friends and colleagues felt, and still feel, that he would have been much happier as a member of a teaching faculty, and are glad that his last nineteen active years were spent in that role.

In the 1960's the AAS had no Division for Planetary Sciences (DPS), and the group organized an annual series of five Arizona Conferences on Planetary Atmospheres. By 1967 several members of the community felt that a DPS was needed; the AAS Council asked Joe to serve as chair of the organizing committee, and when the Division was formed he became the first Chairman. In 1971, he became Director of the NASA Lunar Science Institute and a few years later Professor of Space Physics and Astronomy at Rice University (Houston). After retirement as Professor Emeritus in 1992, he returned to Tucson where he continued an active interest in golf, opera, chess and satirical humor.

Joe's program at Yerkes began with observations of aurora and airglow, making use of the wonderful spectrographs designed and built by Meinel. Among his many contributions was the identification and analysis of a band system in the airglow that now bears his name. His interests shifted toward the theoretical; for example, he applied the radiative-transfer theory of his colleague Chandrasekhar to the sodium twilight airglow. In 1961 he published *Theory of the Aurora and Airglow*, a book so influential that it was reprinted a few years ago by the American Geophysical Union. In the same period his interest in interplanetary hydrogen led to a low-velocity model that was at odds with Eugene N. Parker's model of the solar wind, and a debate ensued until observations showed Parker to be essentially correct. But the Chamberlain ideas were applied to the structure of the Earth's hydrogen exosphere, and for 40 years this work has been accepted as definitive. Later he studied the reduction of the hydrogen escape rate by the ''cooling'' that results from the loss of the energy carried by the escaping atoms.

Joe was selected to deliver the 1961 Helen Warner lecture and chose the topic ''The upper atmospheres of the planets.'' This paper clearly expounds the method by which the exospheric temperature can be calculated and applies it to Mars; it has been the basis of subsequent papers by many workers. After he returned to academic life at Rice in 1973, he collected his notes from a graduate course into the 1978 book *Theory of Planetary Atmospheres*, a second edition of which appeared in 1987 (with the collaboration of the undersigned). His other interest included early studies of changes in the ozone layer and the possible devastating effects from what has now become recognized as global warming.

He is survived by his wife of 54 years, Marilyn; daughter Joy of London; sons David of Austin and Jeffrey (Joel) of Seattle; and granddaughter Jacqueline. His brother Gilbert and numerous nieces and nephews also survive him.

Donald M. Hunten
University of Arizona

LEVERETT DAVIS, JR., 1914 – 2003

Professor Leverett Davis Jr., Professor of theoretical physics at the California Institute of Technology, died on June 15, 2003 after a long illness. He was 89 years old. He contributed many important ideas and concepts to theoretical astrophysics and was a pioneer in the in situ scientific exploration of space using observations from spacecraft.

Leverett Davis

Davis was born in Elgin, Illinois on March 3, 1914, the eldest of four children of Louis Leverett Davis and Susan Gulick Davis. His parents moved several times as he grew up because his father, a mining engineer, became involved in different mining operations in the American West. Leverett married Victoria Stocker in June 1943. They had two children who died in childhood and subsequently adopted a son, Jeffrey. His wife and son survive him.

Davis's early education was rather fractured and uneven because of the many family moves, with periods of home schooling alternating with regular school. His high school education was, on the other hand, reasonably normal. It was while in high school that he decided that he wanted to do physics or mathematics. He went on to earn his Bachelor of Science degree at Oregon State College in 1936, after which he started graduate studies at the California Institute of Technology, to pursue a graduate degree in physics. His advisor was William V. Houston and Davis received his PhD in 1941 for a thesis on electrical properties in nerves. He briefly entertained the idea of changing to work in biophysics.

During World War II, Davis became an integral member of the Caltech project for rockets, which developed a number of different types of rockets used in the war. As a result of this war work, Davis wrote a book on Exterior Ballistics, published by Van Nostrand in 1958.

He joined the faculty at the California Institute of Technology in 1946, after several years on campus as an instructor. In all, he taught there for nearly four decades before retiring as Professor of Theoretical Physics in 1981. For Davis, teaching was a serious endeavor that involved conscientious preparation of class lectures the night before presenting them. He particularly delighted in problems in mechanics, in contrast to his own area of research, and was known among students for his problems involving ''multiple monkeys and multiple pulleys.''

His research interests spanned a wide range of areas in astrophysics, but focused mostly on the physics of magnetic fields and charged particles in astrophysical objects, including in situ observations from spacecraft.

Magnetic Fields and Plasmas: Some of Davis's most important papers came out of a collaboration with Jesse Greenstein in the early 1950's and concerned the interpretation of the observed polarization of starlight as due to the partial alignment of interstellar dust grains, as a result of their interaction with the interstellar magnetic field. This became the standard interpretation of the polarization and only recently have improved models appeared. This early foray into magnetic fields led to a lifelong interest in astrophysical and, later, heliospheric magnetic fields and their interactions. He wrote significant papers on the acceleration and diffusion of cosmic rays resulting from their interaction with the complicated electromagnetic fields in space. Collaborations with L. Biermann and R. Luest in Germany led to further significant papers, in particular one that reported on the discovery of an important new kind of non-linear wave in collisionless plasmas by Davis, Luest and A. Schlueter.

Space Physics: In 1955, well before the continuous solar wind was predicted or established, Davis was sole author of a remarkably prescient paper in which he suggested that particles flow out, more or less continuously, from the Sun, to inflate a spheroidal cavity in the interstellar medium, approximately 200 AU in radius. The existence of this cavity (now called the heliosphere), carved out by the solar wind, is now well established. The radius of the heliosphere is not yet known for certain, but is certainly greater than some 90 AU (the current distance to the Voyager 1 spacecraft), and probably of the order of, or perhaps greater than, 100 AU. Observational and theoretical investigations of the boundary of this cavity are currently a very active area of research.

In the 1960's, Davis's interests in astrophysical and solar magnetic fields, energetic particles and plasmas led naturally to investigations in the new field of space physics, where observations from spacecraft were revolutionizing our understanding. He wrote important papers unraveling the basic physical processes governing the motions of trapped particles in the radiation belts of planets such as the Earth and Jupiter. This work led naturally to his deep involvement in the early space program, where detailed in situ observations of these phenomena became possible. He became a consultant to one of the early companies developing spacecraft, and this led to a number of pioneering contributions to our understanding of interplanetary space.

Davis was one of the true pioneers in the exploration of the plasmas and their associated magnetic fields in space using in situ observations from spacecraft, which began in the late 1950's. He participated effectively as a co-investigator in several of the early planetary missions to Venus in 1962 (Mariner 2), to Mars in 1964 (Mariner4), to Jupiter in 1973-74 (Pioneer10, 11) and to Saturn in 1989 (Pioneer11). The Pioneer spacecraft returned data for nearly 30 years, until the last signal was received from Pioneer 10 in 2002. He continued working on spacecraft data until the early 1980's when he retired.

In both his personal and professional life, Davis was a man of very high standards and great personal integrity. He was a devoted family man who enjoyed nothing more than a road trip including camping, with his family. He was serious about his work and responsibilities, but also had a subtly infectious sense of humor.

J.R. Jokipii
University of Arizona

LYNNE KAREN DEUTSCH, 1954 – 2004

It is with deep sadness and regret that we note the passing of our dear friend and colleague Prof. Lynne K. Deutsch. Lynne died on 2 April 2004 after a protracted illness and lengthy battle with complications caused by the blood disease Polycythaemia Vera.

Lynne was born in Chicago on 26 November 1956 to Victor and Ailsa Deutsch. She lived with her family in the town of Morton Grove, IL until she was 8 years old, when they moved to Beverly Hills, CA. She was an outgoing child who played basketball and excelled in her studies. She graduated from Beverly Hills High School at the age of 16 after completing all high school requirements in only three years. Lynne had a beautiful singing voice, and was in the chorus in high school and college.

Lynne earned her first bachelor's degree in philosophy from the University of California at Berkeley in 1977. She then returned to Berkeley and received a second bachelor's degree, this time in physics, in 1981. She was a graduate student and teaching assistant at MIT and earned an MS in physics from MIT in 1983. Lynne then attended the astronomy graduate program at Harvard University, where she earned her MA in 1985 and PhD in 1990. During her degree studies she began crafting mid-infrared instrumentation. These instruments were destined to be used by a host of eager observers to discover, identify, and study many emissions from the Solar System, and galactic and extragalactic sources.

Lynne was a National Research Council Post-doctoral Fellow at NASA Ames Research Center from 1990 - 1992, where she played an important role in the development of the Smithsonian Astrophysical Observatory/University of Arizona Mid-Infrared Array Camera (MIRAC), a well-known and much sought after instrument frequently used in studies of Mercury, Jupiter, the Moon, planetary nebulae, star formation regions, galactic center, young stellar objects, and extragalactic objects.

After leaving NASA Ames Research Center, Lynne taught for several years (1993-96) at Smith College where she had a significant impact on undergraduate research, especially for women, whom she enjoyed mentoring. Lynne joined the faculty in the Astronomy Department of Boston University in 1996 where she taught instrumentation principles and techniques to undergraduate and graduate stu-

Lynne Deutsch

dents. Over the course of her faculty career, she received numerous research grants and fellowships that were used to support her research, her students, and her postdoctoral associates. She was the principal investigator of Boston University's advanced technologies and instrumentation program MIRABU: A Mid-Infrared Array.

As her health declined and the rigors of a full teaching schedule became unacceptably taxing, Lynne took a leave of absence from Boston University and returned to Harvard University and the Center for Astrophysics in 2001. There she became a very active member of the Infrared Group in the OIR Division and a member of the IRAC/Spitzer Space Telescope team. Her research in infrared astronomy covered many areas including star formation, planetary and protoplanetary nebulae, solar system objects, the interstellar medium and infrared-luminous galaxies. Her most recent research with the Infrared Array Camera (IRAC) on the Spitzer Space Telescope concentrated on high-mass star formation and the related evolution of the interstellar medium. In her short life, Lynne made many devoted friends and colleagues and was active in encouraging school-age girls to pursue their interests in the sciences. In her short career, she published more than seventy-five articles. She was an outstanding observer and instrumentalist, whose promising career was tragically cut short.

Lynne was also a devoted mother and wife, and, while still well, she found the time to be an active participant in her son's elementary school. She is very greatly missed by her family. She is survived by her husband Douglas Sondak, PhD and her son Reed Deutsch-Sondak who live in Acton, MA, and her parents and sister Judith who reside in California.

Lynne will be forever missed by her family, friends, colleagues, and the astronomical community. Her contributions will continue to benefit the community for many years to come. We only wish she were here to share them with us. She will be remembered as a dear friend, colleague, accomplished scientist, and dedicated family member.

Ann L. Sprague
University of Arizona

THOMAS MICHAEL DONAHUE, 1921 - 2004

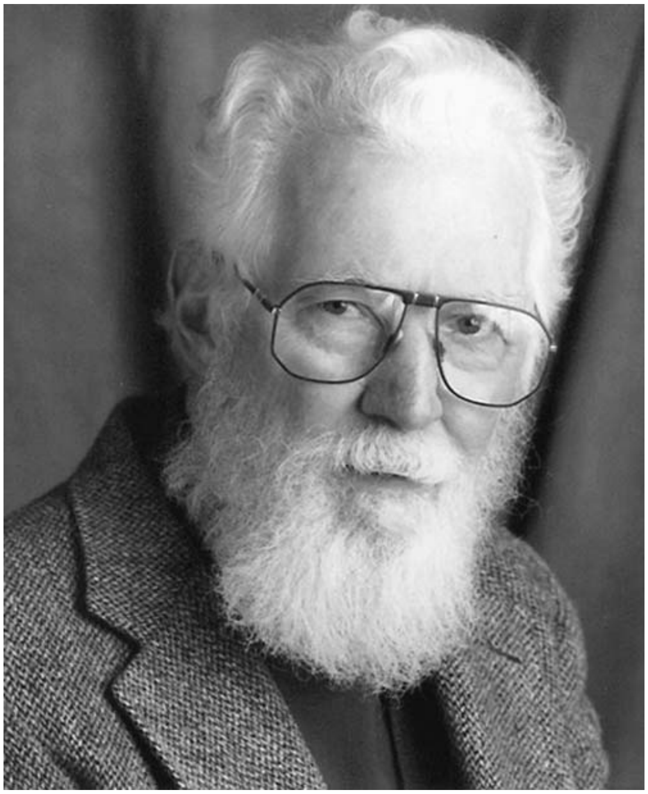
Thomas M. Donahue, one of the nation's leading space and planetary scientists and a pioneer of space exploration, died Saturday October 16, 2004, from complications following heart surgery. The Edward H. White II Distinguished University Professor of Planetary Science at the University of Michigan, Tom shaped space exploration through his scientific achievements and policy positions. His work started with the first use of sounding rockets following World War II and continued for almost 60 years.

Tom was born in Healdton, Oklahoma on May 23, 1921 to Robert Emmet and Mary (Lyndon) Donahue. His father was a plumber in the oil fields when Tom was born (Healdton OK was an oil town) and worked as a plumber in Kansas City for a time. Tom grew up in Kansas City, graduating in 1942 from Rockhurst College in that city with degrees in classics and physics. His graduate work in physics at Johns Hopkins University was interrupted by service in the Army Signal Corps. He obtained his PhD degree in atomic physics from Hopkins in the fall of 1947.

After three years as a post-doctoral research associate and assistant professor at Hopkins, Tom joined the University of Pittsburgh Physics Department in 1951. At Pittsburgh he organized an atomic physics and atmospheric science program that led to experimental and theoretical studies of the upper atmosphere of the Earth and other solar system planets with instruments flown on sounding rockets and spacecraft. He became Professor of Physics in 1959 and eventually Director of the Laboratory for Atmospheric and Space Sciences and the Space Research Coordination Center at the University. In 1960 he spent a sabbatical year on a Guggenheim Fellowship at the Service d'Aeronomie in Paris, which began collaborations with French colleagues that flourished for more than 40 years.

In 1974 he became the Chairman of the Atmospheric and Oceanic Science Department, University of Michigan, a position he held until 1981. In 1986, he was named the Henry Russel Lecturer at the University of Michigan, the highest honor the University confers on a faculty member, and received the Atwood Award for excellence in research in 1994.

Elected to the National Academy of Sciences in 1983 and to the International Academy of Astronautics in 1986, Tom was a Fellow of the American Geophysical Union and the AAAS, and received an honorary degree of ScD from Rockhurst College in 1981. The same year he was awarded the



Thomas Donuhue

Arctowski Medal by the National Academy of Sciences and the John Adam Fleming Medal by the American Geophysical Union. He received the NASA Distinguished Public Service Medal, two NASA Public Service Awards, the Space Science Award of the American Institute of Aeronautics and Astronautics, and the National Space Club Science Award.

From 1982 to 1988 he was Chairman of the Space Science Board of the National Research Council of the National Academy of Science, where he was a strong advocate for unmanned space science missions within the federal space budget. He also served on numerous governmental, NRC, and National Academy of Science advisory boards and committees, and was an officer on the boards of several university consortia, such as the University Corporation for Atmospheric Research and the Universities Space Research Association. He recently served terms as chairman of the Visiting Committee for the Space Telescope Science Institute, the Arecibo Advisory Board and Visiting Committee, the Max Planck Institute for Aeronomy, and the Committee to Visit the Department of Earth and Planetary Sciences at Harvard University. He was Chairman of the Committee on Public Policy of the American Geophysical Union and authored more than 200 research publications.

Tom's influence in space exploration spanned many decades and diverse projects. He was an experimenter or interdisciplinary scientist on the orbiting Geophysical Observatory Missions, Apollo-17, Apollo-Soyuz, Voyager, Pioneer Venus Multiprobe and Orbiter, Galileo, Comet Rendezvous Asteroid Flyby, and Cassini. Based on observations by the Pioneer Venus entry probe, he concluded that Venus once had an ocean before a runaway greenhouse effect led to its current state. Analyzing similar data from Martian meteorites, he again argued for a substantial Martian ocean, anticipating the current series of missions to Mars. In these and many other cases he laid the foundation for our current understanding of planetary atmospheres.

In 1999, Tom described his career this way, ''I parlayed my training in atomic physics into a faculty position at Pitt, doing research in aeronomy and laboratory studies of atomic physics. This led to rocket and satellite exploration of the upper atmosphere of Earth in the 60s and spacecraft exploration of Mars, Venus and the Outer Planets beginning in the 70s. Along the way my students, post-docs and I were deeply involved in the problem of anthropogenic destruction of the stratospheric ozone in the early 70s. This led to my continuing interest in global change.''

Throughout his life Tom retained a keen interest in the history of his family in Ireland, as his mother and grandfather both emigrated from County Kerry. He studied oral and written sources, writing as early as 1942 on the family and the early history of the Eóghanachta Rathleinn. Recently his efforts supported the establishment of the international O'Donoghue society, in particular spearheading a project that continues to reveal fresh detail about family migrations from the High Kings to the Cromwellian period.

Tom brought his powerful intellect and drive to a broad range of lifelong passions beyond science. Fluent in several languages, from classical Greek to modern Irish, he was also widely read in American, Irish and French history and literature, and was an exacting student of French wine. He loved classical and folk music, often singing hundreds of songs for his family in keys only he knew. A devotee of tennis, he continued playing weekly matches until early 2004, and was able to attend one last ceremony honoring him when the University of Michigan and his home department, awarded his friend and fellow Space Science Board chair, Lennard Fisk, the ''Thomas M. Donahue Collegiate Professor of Space Science.''

He is survived by his wife of 54 years, Esther McPherson Donahue of Ann Arbor, Michigan; their three sons -- Brian of Boston MA, Kevin of Berkeley CA and Neil of Pittsburgh PA; six grandchildren; a brother, Robert Donahue, and sister, Mary Marshall, both of Missouri.

Tamas Gombosi
University of Michigan

JULENA STEINHEIDER DUNCOMBE, 1911-2003

Julena Steinheider Duncombe died on 13 September 2003, just eight days before her 92nd birthday.

Julena Steinheider was born September 21, 1911 on a farm in Dorchester, Nebraska and grew up in Goehner, Nebraska. Her parents were Frederick and Ella Beenders Steinheider, and she had four brothers. She began college at the age of 17 and graduated at 21 from Doane College in Crete, Nebraska with a major in mathematics and a minor in astronomy. She started teaching in a one-room schoolhouse, where, with assistance from her family, she started possibly the first school lunch program by fixing lunches on the schoolhouse stove to provide food for children who only had popcorn to eat. Then she taught in Minatare and Scotts Bluff, Nebraska, and in a Japanese Relocation Camp in Wyoming.

Julena Duncombe

In 1945 she moved to Washington DC to begin working at the US Naval Observatory (USNO). She was the first woman observer on the 6-inch transit circle. She worked as an observer and mathematician reducing and analyzing observations of the Sun, Moon, planets, and stars. At the Naval Observatory she met Raynor Duncombe and married him in Goehner, Nebraska, in January 1948. She resigned from the USNO in 1948 to go with her husband to Yale University. At Yale the Duncombes introduced punched card equipment into the Astronomy Department. Ray also took graduate classes and Julie worked on Astrographic Catalog reductions.

Upon returning to USNO in 1950 she joined the Nautical Almanac Office. She supervised the punched card operated typewriter to produce tables of positions of celestial bodies for air and sea navigation. With Dorrit Hoffleit she directed the keypunching of over 150 star catalogs, approximating 1.5 million cards. Several thousand errata to the catalogs were discovered and corrected on the cards and tape versions of the catalogs. This activity was the basis for future stellar databases. From 1963 she was responsible for producing the tabular predictions and maps for solar and lunar eclipses, which appeared in the almanacs and special circulars. After 28 years at the U S Naval Observatory she retired in 1973.

In 1975 the Duncombes moved to Austin, Texas. There she supported Ray, who was executive editor of *Celestial Mechanics,* serving as associate editor of the journal. Throughout their lives in Washington and Austin the Duncombes were gracious hosts for overnight guests and for dinner parties. Julie was very experienced at giving both small and large dinner parties for foreign visitors, USNO staff, graduate students and others. They also hosted people at their mountain house in Highlands, NC.

Julie Duncombe was a fellow of the American Association for the Advancement of Science, a member of the American Astronomical Society, Division on Dynamical Astronomy, American Association of University Women, and the Institute of Navigation. She was a proponent for women having careers in mathematics and science. In 1959 the Department of Labor featured her career at the USNO as an example of what women in Federal Service could accomplish.

In her later years she suffered from macular degeneration and Alzheimer's disease. She is survived by her husband of 55 years, Raynor Lockwood Duncombe; stepson Raynor Bailey Duncombe and wife Janice of Middleburg, NY; grandchildren Raynor Luccioni Duncombe and wife Heidi of Charlotte, NC and Christina Luccioni Duncombe of Williamsburg, VA.

Kenneth Seidelmann
University of Virginia

RICHARD JOSEPH ELSTON, 1960 - 2004

Richard Joseph Elston, known for his development of innovative astronomical instrumentation, died on 26 January 2004 in Gainesville, Florida, after a four-year battle with Hodgkin's lymphoma. A professor of astronomy at the University of Florida, Richard had an unusually broad range of interests and skills, and a willingness to share his passion for astronomy with others, which made him a highly valued member of the astronomical community.

Born 1 July 1960, in Albuquerque, New Mexico, Richard was the son of a geologist father and journalist mother. His childhood interest in astronomy and instrumentation matured as he majored in physics and astronomy at the University of New Mexico (BS, 1983) under the mentorship of Michael Zeilik. Richard pursued his PhD in astronomy at the University of Arizona and earned his degree in 1988. He pioneered the use of IR arrays for deep imaging surveys of the sky to study galaxy formation, and completed his thesis *Search for Rapidly Forming Galaxies at High Redshift* under the direction of George Rieke.Richard's graduate work included the first detection of galaxies at intermediate redshifts with evolved populations too red to have been identifiable from optical imaging surveys alone. In the *Astrophysical Journal Letters* in 1988, he, George Rieke, and Marcia Rieke reported the discovery of this new class of galaxies, now known as EROs (Extremely Red Objects), important as the possible progenitors of present day elliptical galaxies.

Following post-doctoral positions at Kitt Peak National Observatory from 1988 to 1991 and at the Observatories of the Carnegie Institution of Washington from 1991 to 1992, Richard joined the scientific staff of Cerro Tololo Inter-American Observatory in Chile, part of the NSF's National

Richard Elston

Optical Astronomy Observatory. By 1994, he had become head of CTIO's IR instrumentation program and was leading the development of new instruments for the US astronomical community.

In 1996, Richard married astronomer Elizabeth Lada, and both joined the faculty of the University of Florida. They worked closely together and with their colleagues to develop the department into a leading center for astronomical research. Richard assembled a strong near-IR instrument team whose most recently completed instrument was FLAMINGOS**,** the **FL**orid**A** **M**ulti-object **I**maging **N**ear-IR **G**rism **O**bservational **S**pectrometer. FLAMINGOS serves as both a wide-field IR imager and multi-object spectrograph. Successfully used at the 6.5-m MMT Observatory, 8-m Gemini South telescope, and KPNO 2.1-m and Mayall 4-m telescopes, FLAMINGOS allows scientists to complete observations in one night that would previously have required 100 nights. FLAMINGOS is the primary instrument for several major survey programs that are studying topics ranging from how individual stars and planets form to how the largest structures in the Universe evolve.

One of Richard's innovations with FLAMINGOS was the use of a separate ''pre-dewar'' that maintains at cryogenic temperatures the multi-slit masks required to select the targets for observation, but can be thermally cycled more quickly than the entire instrument. This feature allows the changing of masks on a nightly basis. New instruments having the innovations pioneered with FLAMINGOS are under construction and are to be used at several of the world's largest telescopes in the decades ahead.

Richard was involved in getting both the University of Florida and the U.S. astronomical community on the path toward larger telescope facilities. He played a crucial role in the University of Florida's joining the team building the10.4-m Grand Telescope of the Canary Islands. As a member of the panel that studied optical/near-IR astronomy from the ground for the most recent (2000) National Academies decadal review of astronomy, Richard was a passionate advocate for open access to the next large (30-m class) telescope to be built. The final report included a recommendation for a public role in such a telescope. Richard's work as a researcher and educator was recognized in 2000, when he was named a recipient of the Presidential Early Career Awards for Scientists and Engineers.

With the birth of his son, Joseph, in 1999, Richard's life reached an important milestone. During his battle with cancer, Richard awed everyone with his ability to be productive professionally and still be so devoted to his family. He and his son shared a love for the outdoors and adventure. Richard was an expert SCUBA instructor, skier, hiker, wind surfer, airplane pilot, and sailor. Joseph is already a ''proto- naturalist.'' Richard will be best remembered as a wonderful father, beloved husband, loving brother, son, uncle, friend and inspiration to all whose lives he touched.

Buell T. Jannuzi
National Optical Astronomy Observatory

Jill Bechtold
University of Arizona

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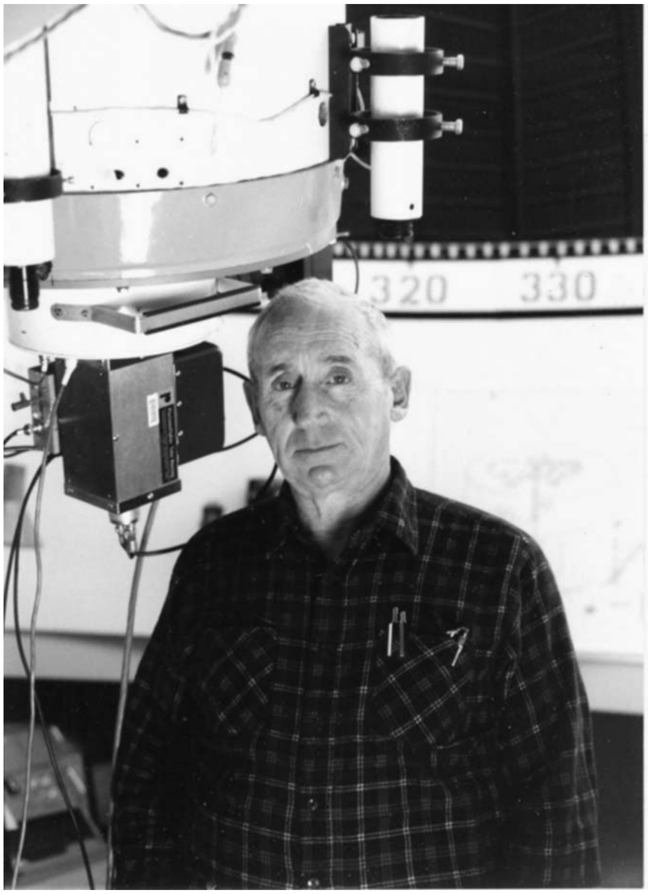
ROBERT E. FRIED, 1930-2003

Professionals and friends knew him as Captain Bob; he was the captain of his airplane, Birdie, and of his observatory, Braeside. He was a man of many talents, and he incorporated those talents into his two main passions in life: flying planes and doing astronomical research.

Bob was born on December 14, 1930 in St. Paul, Minnesota to parents Dr. Louis and Emily Fried. His interest in astronomy began after he moved to Atlanta in the late 1950's as a pilot for Delta Airlines. It was there he joined the Atlanta Astronomy Club in 1960 and went on to become its President and also the President of the Astronomical League. Wanting a larger and better telescope than the usual department store variety, he took the advice of Patrick Moore, who suggested he build one himself. So he did. He obtained a military blank for a 16-inch Cassegrain and ground and polished the optics while the heavy parts were machined in the Delta Airlines shops after hours. His observatory protruded from the roof of his home and featured a modified silo dome, while the observer's controls were reminiscent of an airplane cockpit.

When it became obvious that the Atlanta climate offered little support for serious

Astronomy, Bob moved his family and observatory to a higher, clearer site in the Rockies. There he built a new dome on Flagstaff Mountain near Boulder. Subsequent to meeting and conspiring with fellow enthusiast Edward Mannery, who became his lifelong collaborator, Bob upgraded his system for digital photometry and began to obtain magnitudes to a few percent accuracy. After grumbling about the windy and cloudy weather of the Rockies, Bob tried a site near Lowell Observatory and then finally settled on the best home for Braeside in 1976, a short walk through the pines from the US Naval Observatory. He ultimately created a building he



Robert Fried

dubbed ''The Monastery'' after Mt. Wilson, that housed a bedroom, darkroom, electronics shop, machine shop, library and telescope control console and upgraded his detectors to a CCD system in 1995. It was with this Observatory that he ultimately realized his dream of a computer automated observation system that would run unattended until sunrise. His web page stated the Mission of Braeside Observatory as ''To make available through collaboration, research data requested by members of the astronomical community worldwide.'' It was Bob's ability to produce long strings of high quality data that led him to become known, mostly by word of mouth, to professional astronomers around the world, first in the variable star community and then in other fields as well.

The high quality of his observations and his ability and interest in close binary stars (cataclysmic variables) led him to be one of the first people contacted when observations were needed simultaneous with spacecraft data for multi-wavelength coverage or just for follow-up observations on some peculiar object that had been discovered. His ability to set up his program, let it run and close up automatically meant he could accomplish observations and yet sleep through the night. Captain Bob could be counted on to deliver the data fully reduced the morning after the observations, even though the space data might be months in arriving. ADS lists 117 publications from Bob, on topics that started with eclipsing binaries and expanded to ultimately include RS Cvn, RcrB, RR Lyr, Delta Scuti stars, as well as X-ray transients and his special love, cataclysmic variables. But he also worked on variable extragalactic sources, including Seyferts, BL Lacs, and Blazars. In June 1997, he attended the13th North American Workshop on Cataclysmic Variables in Teton Park, to the delight of members of the community who could finally meet the person who had made so many contributions to their programs. However, this obsession did not go without cost to his family. His dedication to observations and his equipment meant many missed dinners and family gatherings and was a source of much family ribbing.

In order to insure Braeside would continue to operate long after he could not be present, Bob and his wife, Marian, donated his observatory and adjacent home to the Arizona Sate University astronomy department for student use. In the last years of his life, he made sure everything worked for the students who used it in the early evening hours and then he continued on with his own research programs in the later half of the night and on weekends.

His interest in students was not limited to those using his own telescope, although many visited and used his observatory from as far away as New York. Bob made an effort to work with students in other schools. He helped Flagstaff High School to build their own observatory on their grounds and worked with students from other states.

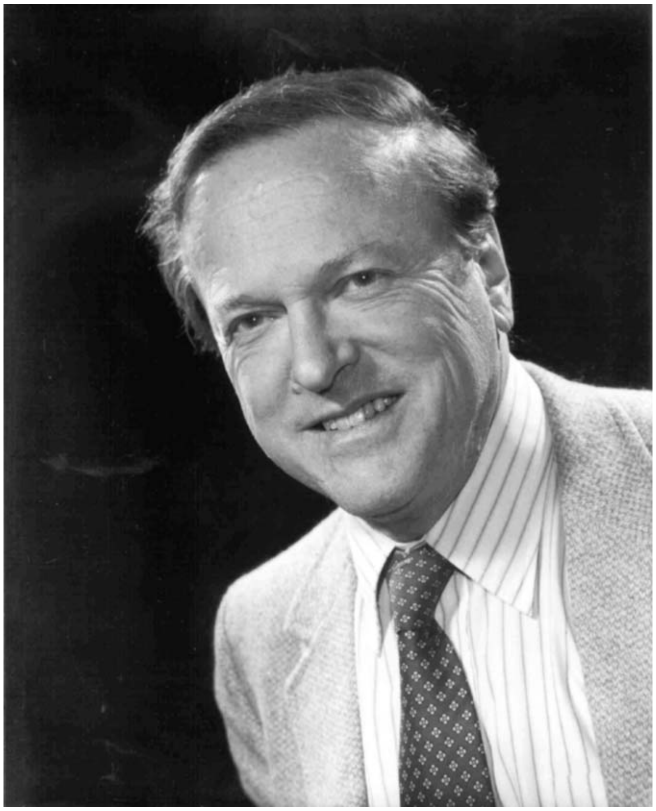
Besides his night observing programs, Bob continued with his love and expertise in flying during the day. He donated his plane and time for volunteer mercy missions with Angel Flight and Flights for Life, flying patients to hospitals and medical supplies where they were needed. It was on one of these missions that Birdie went down about 40 miles north of Phoenix on November 13, 2003. The cause of the plane crash was not clear but the outcome was certain: the world had lost an admired, professional amateur astronomer and humanitarian. He is survived by his wife, Marian, his sister Louise, and his three daughters, Leslie, Sara and Amy, as well as stepchildren, grandchildren and many students he mentored. The stories told, and the pictures shown, at his Memorial at Lowell Observatory summarized a free-spirited and dedicated individual who lived life fully, joyfully and generously. His sense of humor, and spirited camaraderie will be missed as much as his observations.

Edward J. Mannery and Paula Szkody
University of Washington

THOMAS GOLD, 1920-2004

Thomas "Tommy" Gold died of heart disease at Cayuga Medical Center, Ithaca NY on 22 June 2004 at the age of 84. He will be remembered as one of the most interesting, dynamic and influential scientists of his generation. Tommy's paradigm-changing ideas in astronomy and planetary science, while original and bold, were also highly controversial. With his radical work on the origin of natural gas and petroleum, the controversy is likely to continue.

Tommy was born in Vienna, Austria on 22 May 1920, moving with his family to Berlin at age 10 and then, after the rise of Hitler in 1933, to England. His parents were Josephine (nee Martin) and Maximillian Gold, a successful steel magnate. Tommy was educated at Zuoz College in Switzer-



Tommy Gold

land where he became an expert skier and developed an athletic prowess that he maintained throughout his life, winning a NASTAR gold medal for skiing at the age of 65. He studied Mechanical Sciences at Trinity College, Cambridge, but much to his disgust his education was interrupted because of internment by the British as a suspected enemy alien. That unfortunate period (I remember him saying to me ″Can you believe the stupidity, interring people like me who had fled from Nazi Germany?″) had one good outcome: on his first night in camp he met Hermann Bondi who had an important influence on his early development as a scientist. They were both born in Vienna, their parents knew each other, and they were fellow students at Trinity, but this was their first meeting. On release, he went immediately into top- secret radar research for the British Admiralty, working as a team with Bondi and Fred Hoyle in a farm cottage in Dunsfold, Surrey.

Tommy's first published research, which was a Nature paper with R.J. Pumphrey in 1947, was not in astronomy but physiology. He applied his engineer's understanding of positive feedback to develop and test a resonance model for how the human ear determines pitch. His conclusion that pitch discrimination occurs physically in the inner ear and not in the brain was largely ignored at the time, but has since been proved correct.

At about the same time, he started work with Bondi and Hoyle on the steady state theory of the universe. This attractive hypothesis, which was proposed by Tommy, supposes that the universe is infinite in both time and space, but to reconcile this with Hubble's observations of receding galaxies, matter needs to be created continuously. This struck the trio as no more shocking than creating all of the matter all at once. Tommy stated that ″in choosing a hypothesis there is no virtue in being timid.″ The steady state theory stimulated one of the greatest cosmological debates of the twentieth century. The initial opposition to the theory, led by Martin Ryle, was based on number counts of radio sources. Current observations, particularly of the thermal cosmic background radiation, support the rival theory that Hoyle derisively named the Big Bang. The rivalry stimulated much observational radio astronomy and theoretical work on the origin of elements; one positive outcome for Tommy was that he argued that some of the radio sources observed by Ryle must be external to our galaxy and in that, he was certainly correct.

Some of the other problems that engaged Tommy can also be traced back to early conversations with Bondi and Hoyle. In 1955, Hoyle outlined ″Gold's pore theory″ and the abiogenic origin of hydrocarbons in his book *Frontiers of Astronomy*, contrasting those ideas with the ″curious theory that oil is derived from dead fish.″ In later years, Tommy was to expand on those ideas, linking the origin of all hydrocarbons to primordial processes that survived the formation of the Earth and Moon. The observation that all petroleum contains clear signatures of biological activity led him to propose that the Earth has a ″deep hot biosphere″ and it is the action of microbes feeding on methane seeping up from deep in the mantle that gives petroleum the imprint of life.

Tommy made novel and ingenious contributions to many other areas of astronomy, ranging from electromagnetic and dynamical processes in the solar system, to the origin of solar flares, cosmic rays and pulsars. At a time when celestial mechanics was largely concerned with determining the positions and masses of planets and satellites, Tommy suggested to his student Peter Goldreich that the observed excess of orbital resonances amongst the satellites might involve tidal evolution. Goldreich's work on this fruitful topic was later extended by Stanton Peale, another of Tommy's former students, to account for the spectacular melting of Io by tidal dissipation. His work on lunar dust was controversial partly because in lectures and popular articles he raised the possibility, using the analogy of snow-covered glacial crevasses, that deep layers of dust could pose a threat to astronauts. However, his suggestion that the Moon is covered in a layer of dust was essentially confirmed by the Apollo lunar landings. But, while he was right to suggest that the color of the Moon is determined by the space weathering of this dust, he was wrong to argue that the lunar maria are not lava. Shortly after the discovery of pulsars, Tommy suggested that they are rapidly rotating, magnetized, neutron stars whose magnetospheres (a word that he coined) reached the light cylinder beyond which particles could not rotate. This initially controversial idea (he was not allowed to present it at one meeting) was widely accepted after the discovery of the pulsar in the Crab nebula. Tommy showed that particles electromagnetically accelerated by a neutron star could generate cosmic rays, and he linked the resultant power loss with the observed braking of the pulsar's spin.

His unusual talents received early recognition and garnered him many honors. For his brilliant work on human hearing he was awarded a Fellowship at Trinity College.

After switching to astronomy, he was appointed Chief Assistant to the Astronomer Royal in 1956, but soon left England for greater opportunities in the United States. He spent two years (1957-58) at Harvard, first as a professor and then as the Robert Wheeler Willson Professor of Applied Astronomy before accepting positions as chairman of astronomy and Director of the Center for Radiophysics and Space Research at Cornell University in 1959. He took great pride in the astronomy department that blossomed into greatness under his leadership. The department, which only had one other faculty member when he was appointed, reflected Tommy's strengths, ranging from radio astronomy and the Arecibo dish, to infrared, theoretical and planetary astronomy. His many distinguished hires included Carl Sagan. At Cornell, he was Assistant Vice President for Research from 1969-71 and the John L.Wetherill Professor from 1971 until his retirement in 1987. His many honors included Fellow of the Royal Society (London); Member of the National Academy of Sciences (US); Gold Medal and George Darwin Lecture, Royal Astronomical Society, London; and Honorary Doctor of Science, Cambridge University. He also served on the US President's Science Advisory Committee, although he came to be a strong critic of NASA and the Shuttle program.

Tommy was a handsome, charming and generous man and a loyal colleague who formed many long-lasting friendships. A witty and articulate speaker, he was regarded by some as a scientific maverick who delighted in controversy. In reality, he was an iconoclast whose strength was in penetrating analysis of the assumptions on which some of our most important theories are based.

He is survived by his second wife, Carvel (nee Beyer) Gold of Ithaca whom he married in 1972, and by the couple's daughter, Lauren Gold of West Palm Beach, Florida, as well as by three daughters from his first marriage to Merle Eleanor Tuberg in 1947: Lindy Bryant of Philadelphia, Lucy Gold of Ithaca and Tanya Vanesse of Carmel, N.Y., and by six grandchildren. He was predeceased by a sister, Elisabeth Carter.

Photo credit: Photograph by Herman J. Eckelmann, Ithaca, New York

Stanley F. Dermott
University of Florida

R(OYAL) GLENN HALL, 1921–2004

R(oyal) Glenn Hall

R. Glenn Hall died on 25 June 2004 following a battle with prostate cancer. His contributions to the determination of the frequency corresponding to an energy level transition in the Cesium atom led to the definition of the length of the second and formed the basis for precise modern timekeeping.

Glenn was born on 23 June 1921 in Koloa, Hawaii, and together with a brother and three sisters, grew up in Albion, Michigan. His father was a professor of political science at Albion College.

He graduated from Park College in Parkville, Missouri with a degree in mathematics in 1941. He served as a corpsman in the U. S. Navy during World War II, and went on to earn a PhD at the University of Chicago in 1949.

Glenn joined the faculty at the University of Chicago as an instructor from 1949 through 1952 and became a research associate there in 1953. While at the U. of Chicago he worked extensively on mass ratios of binary stars, binary star orbits and the determination of stellar parallaxes.

In 1953 Glenn came to the U. S. Naval Observatory (USNO) where he became the Assistant Director of the Time Service Division. His early work at the Naval Observatory was related to the determination of Ephemeris Time (ET) from photographic observations of the Moon with respect to background stars. This work provided a time scale more uniform than that based on the Earth's rotation, which was the internationally accepted time scale at the time. As a result, the International Astronomical Union in 1955 redefined the second to be the second as determined from Ephemeris Time.

In June 1955, L. Essen and J.V.L. Parry placed in operation a Cesium beam atomic standard at the National Physical Laboratory in Teddington, England. William Markowitz (1907-1998), the director of the Time Service, and Hall together with Essen and Parry then began the work leading to the determination of the frequency of the Cesium atom in terms of the second of the seasonally corrected time scale determined from the Earth's rotation and also in terms of Ephemeris Time. The former was accomplished using the observations of stars with the Photographic Zenith Tube (PZT) and the latter from the photographic observations of the Moon.

These same investigators later calibrated the frequency in terms of the ET second using observations made with the USNO dual-rate Moon camera over the period 1955.50 to 1958.25. In a paper published in *Physical Review Letters* in 1958 the cesium frequency was found to be 9 192 631 770 Hz with a probable error of ?±20 Hz. In 1967 the 13th General Conference on Weights and Measures adopted the atomic second as the unit of time in the International System of Units. It was defined as ''the duration of 9 192 631 770 periods of the radiation corresponding to the transition between the two hyperfine levels of the ground state of the cesium 133 atom.'' Therefore, the second of atomic time, the basis for all modern timekeeping, is in principle equivalent to the second of Ephemeris Time.

Glenn went on to lead an international program of Moon-camera observations for the International Geophysical Year in 1957-58 that was extended into the 1960's. His other work at the U. S. Naval Observatory was concerned with the operation of programs using the Danjon astrolabes and PZTs to determine the variations in the Earth's rotation. He also worked with Markowitz to investigate improvements in electronic time transfer techniques using artificial satellites and Loran-C. Other investigations were concerned with the calibration of Hydrogen masers and the formation of time scales.

Hall was a member of the American Astronomical Society and the International Astronomical Union. He retired from the USNO in 1982, and enjoyed an active retirement. He traveled widely, often returning to Hawaii, and pursued his many hobbies: he was an avid bridge player; he had a long interest in stamp collecting and maintained a large garden.

In 1943 he was married to Mary Mowry. They had three children. A daughter, Anne preceded him in death in 1997. His wife and two sons, Thomas, and Robert, and two grandchildren, Garrett and Tarek, survive him.

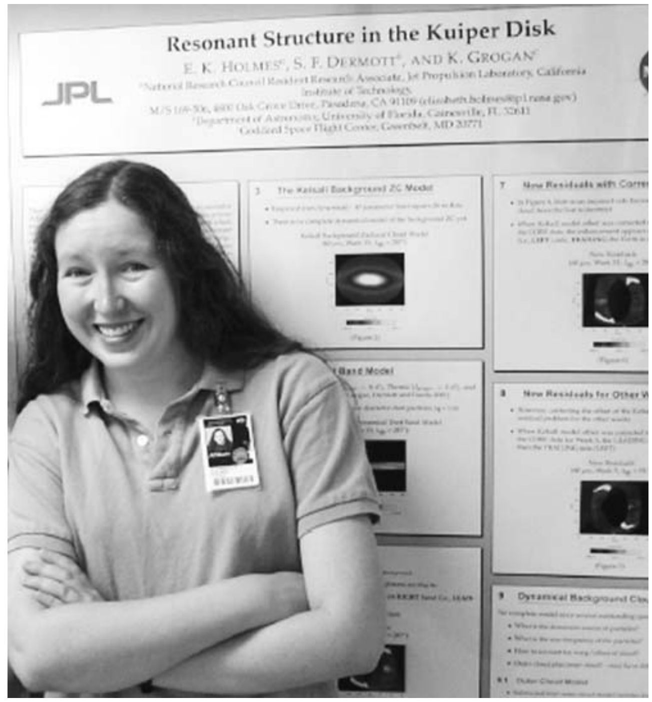
Glenn's scientific work was characterized by a clear analytical sense in the treatment of data. He possessed an ability to recognize systematic phenomena in time series data that were not always evident to his colleagues. This quality together with his friendly, unflappable nature made him a key individual at the Naval Observatory where he could always be approached for his friendly technical advice.

Dennis D. McCarthy
U.S. Naval Observatory

ELIZABETH KATHERINE HOLMES, 1973-2004

Elizabeth (Beth) K. Holmes died suddenly in Pasadena on March 23, 2004, from the unexpected effects of a long-standing heart condition. She was 30 years old. At the moment of her passing, she was at her computer comparing her theoretical models on the effects of planets on the distribution of zodiacal dust with some of the first observations from the Spitzer Space Telescope.

Born on June 24, 1973, in New York City, Beth was the only child of James and Barbara Holmes, who were respectively, a financial manager and a nurse and social worker. Undeterred by numerous treatments and operations to correct a congenital heart condition, Beth developed an interest in math and physics leading to her graduation from MIT in 1995 with a bachelor's degree in Physics. She entered the University of Florida shortly afterwards to begin her PhD studies under the direction of Stanley Dermott. Beth was particularly interested in the dynamics of interplanetary dust, and initially worked on secular perturbations of the zodiacal



Beth Holmes

cloud: how the planets impose warping of the cloud, and how they can force the center of the cloud to be offset from the Sun.

Despite the fact that Beth was primarily a theorist, she was keen to include some observing experience in her PhD education. She recently completed an observing program with Harold Butner at the Steward and Palomar Observatories looking for submillimeter and mid-infrared emission around nearby main-sequence stars - a signpost of planetary formation. The results were published last year in the *Astronomical Journal*. Beth's PhD thesis work, some results of which were recently published in the Astrophysical Journal, focused on dust originating in the Kuiper belt and how some of this dust is expected to be spatially structured due to resonant interactions with Neptune. This phenomenon may be quite common in other planetary systems, with recent images of Epsilon Eridani perhaps providing a prime example of a Kuiper disk analog.

After graduating from Florida in 2002, Beth took up a National Research Council postdoctoral position at the Jet Propulsion Laboratory with Charles Beichman and T. Velusamy with the goal of applying her theoretical knowledge of zodiacal clouds to observations from the Spitzer Space telescope. In advance of the launch of Spitzer, Beth gathered detailed information on over 150 solar type stars and carefully planned a Spitzer observing program to detect faint zodiacal signals. While waiting through numerous launch delays, she prepared models of zodiacal clouds influenced by the presence of planets to be ready when Spitzer images of stars like Vega, Upsilon Andromedae, and Fomalhaut became available. These models were presented as talks and posters at a number of conferences. Her models were a critical part of the Early Release Observations of Fomalhaut and the subsequent Spitzer paper on the possibility that a Jovianmass planet located approximately 40 AU from the star was responsible for the structures seen in the Fomalhaut disk. The Fomalhaut paper in the special Spitzer edition of the Astrophysical Journal is dedicated to Beth's memory.

Beth was an enthusiastic and cheerful colleague who made friends everywhere she worked. In addition to developing friendships and collaborations at JPL, she became a valued member of the Spitzer/MIPS instrument team at the University of Arizona. She was active on the Committee on the Status of Women in Astronomy of the American Astronomical Society, publishing an article on ″The Postdoc Perspective on the Women in Astronomy II Conference″ in the January 2004 issue of *STATUS*, the CSWA magazine, and serving as an associate editor of that magazine. She was an inspiring role model for young women in science, befriending and mentoring a number of Caltech women undergraduates, as well as making numerous appearances in K-12 classrooms for science outreach. She pursued her love of plants (cactus in particular), cats and fish, spending her spare time lovingly tending her small garden.

Her friends and colleagues will remember Beth for her scientific contributions, but also for her courage as we realize that she worked beside us completely unshadowed by the heart condition that would take her in so sudden and untimely a manner. We take solace in the knowledge that at the moment of her passing, she was pursuing her passion for astronomy, working among colleagues who valued her work and her friendship, that she had a supportive and loving family with parents on the East Coast and close relatives on the West Coast, and that in her fiancé, Todd Rope, she had found a kindred spirit.

Charles Beichman
Michelson Science Center
California Inst. of Technology and
Jet Propulsion Laboratory

CHARLES LATIF HYDER, 1930 - 2004

Charles Hyder

My friend and colleague, Charles Hyder, was a true physicist with a sound intuitive grasp of fundamentals in modern physics and the underlying mathematics. I admired his knowledge of the history of modern physics and quantum mechanics when we discussed contemporary problems in interpreting solar observations. He had the ability to present his ideas clearly and persuasively to both students and his colleagues. His insatiable curiosity about life in general led him to consider the effects of nuclear weapons development on the human race. Appreciation of the biological effects of radioactive materials produced in the course of weapons and power reactor development led him to a more public career beyond traditional research.

Charles Hyder was born April 18, 1930 in Albuquerque, New Mexico. He graduated from Albuquerque High School and served in the Air Force during the Korean War. He received a BS and MS in physics from the University of New Mexico (1958, 1960) and a PhD in astrogeophysics at the University of Colorado (1964). His positions included the Department of Astronomy and Institute of Geophysics at UCLA (1964-65), Sacramento Peak Solar Observatory (1965-1970) and the Goddard Space Flight Center (1970 – 1977). He also taught at the University of New Mexico (1970-1977) and was active on the Solar Maximum Mission science team (1970-1977, 1980-1984). He was married twice with both marriages ending in divorce. He and his first wife Ann had three children (Paul, Roxanne and Querida) and he and his second wife Laurie had a son Niels.

Charles Hyder's professional career in solar physics began in 1961 during his graduate studies at the Department of AstroGeophysics of the University of Colorado and continued until 1983 when he chose to follow his convictions to expose the threat of nuclear proliferation. His early research was in the study of the quantum mechanics of polarized light produced in the presence of magnetic fields. Application of this work to interpretation of solar spectra was a basic theme in fifty-one papers published between 1963 and 1983. Charles' interest in solar prominences and flares led him to study the physics of in-falling plasma in solar active regions and the production of the so-called ''two ribbon'' flares associated with active region prominences. His final work in solar physics was done on the Solar Maximum Mission (SMM) in collaboration with colleagues at Goddard Space Flight Center and Marshall Space Flight Center.

After 1983, Charles' devoted his full energy to exposing the threat of nuclear weapons and reactor by-products in the biosphere. His was a very public crusade with a seven month fast in Lafayette Park, Washington D.C. and a vigorous opposition to the Waste Isolation Pilot Plant (WIPP) at Carlsbad, New Mexico. His analysis emphasized the need to understand convection of ''hot'' containers of radioactive waste in the WIPP salt bed. He concluded that the containers would eventually emerge at the surface and be a biological threat. His greatest fear was that dispersal of plutonium in small amounts worldwide was inevitably leading to biological mutation and destruction of life as we know it.

We all remember his imposing stature and the strength of his arguments in discussions of life, physics, and the dangers of radioactive materials dispersed on the Earth. He led an unconventional life where he truly reveled in learning and earnestly worked to make a difference.

Oran R. White
Mancos, Colorado

HENRY EMIL KANDRUP, 1955-2003

Henry Emil Kandrup died on 18 October 2003 at his home in Gainesville Florida. Henry was a theoretical astrophysicist specializing in the application of chaotic dynamics to stellar systems. At the time of his death, Henry was a Professor at the University of Florida where he had taught for 13 years.

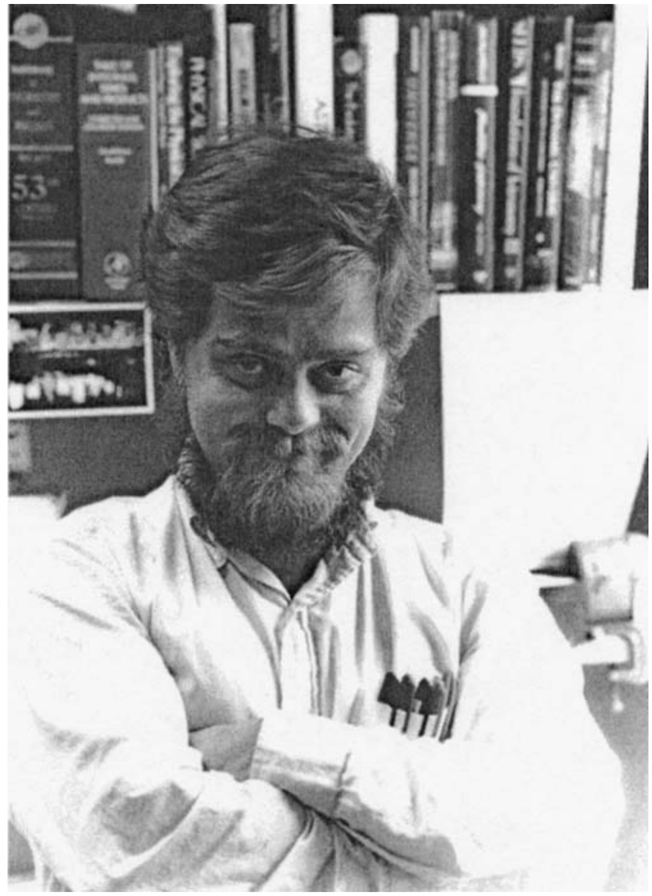
Henry was born in Manhasset, New York on July 24, 1955 and spent most of his childhood in Great Neck. His parents, Jytte and Fred, were immigrants from Denmark where his father had worked as a silver smith. Henry was a precocious child, skipping both third and fifth grades. With the help of Sidney Spivack, a professor of sociology at Columbia University, his parents enrolled Henry in the Brooks Preparatory School in Andover, Massachusetts. After graduating at age 16, Henry enrolled at Cornell, transferring to Princeton the following year.

Henry's parents adored their only child and worked hard to provide him with intellectual opportunities. Henry became an accomplished musician (organ, piano, French horn) and linguist (English, Danish, German) and was a passionate devotee of opera and ballet.

Henry received his PhD in 1980 from the University of Chicago, where his thesis advisor was James Ipser. He taught at Oakland University in Michigan and Syracuse University in New York before coming to the University of Florida in 1990.

Henry was *sui generis*. He shunned conventionality in his personal appearance and in his public demeanor, and always chose forthrightness and candor over polite silence. But to those of us who knew Henry well, his bluntness was a reflection of his intellectual consistency. Henry always said exactly what he thought, both in his published work and his public presentations, and never compromised himself for the sake of appearances. Nothing that he said or wrote was less than fully thought out.

Henry's PhD thesis was entitled ''Stochastic Problems in Stellar Dynamics,'' and most of his subsequent research was in this field. Motion in stellar systems can be stochastic for three reasons: deflection of trajectories by close encounters; non-integrability of the smoothed-out potential; and an oscillating mean field. Henry made important contributions to our understanding of all three sorts of chaos. In a series of papers from the early 1990's, Henry developed the idea of ''chaotic phase mixing,'' the process by which an ensemble of points evolves toward a uniform coarse-grained population of phase space. Prior to Henry's work, the evolution of stellar systems to a steady state was attributed loosely to ''violent relaxation,'' defined as phase-space repopulation driven by changes in the smooth potential. Henry pointed out that changes in the gravitational potential do not by themselves constitute relaxation; at best, they can contribute to relaxation by inducing a degree of chaos in the stellar trajectories. But it is the chaos that is responsible for the mixing and hence for the approach to a steady state.



Henry Kandrup

Among his other important contributions to stellar dynamics were a formal demonstration of the equivalence of Landau damping and phase mixing, and a proof (with J. F. Sygnet) of the linear stability of a broad class of stellar systems. Shortly before his death, Henry was working on the chaotic dynamics of charged particle beams and on the influence of binary super massive black holes on orbital motion in galaxies.

Henry was one of the principle organizers of more than a dozen workshops on non-linear dynamics in astronomy and astrophysics that were held at the University of Florida. At the time of his death, he was negotiating with Springer Verlag over publication of a monograph, *Hamiltonian Galactic Dynamics*.

Henry was famous for the energetic quality of his lectures. Like many other excellent teachers, he drew upon his research to enliven his undergraduate teaching. Under Research Interests, his web site lists ''creative utilization of playdough, margaritas, and spirographs in graduate and undergraduate teaching.'' Henry received numerous teaching citations and awards; he was consistently voted the best teacher in the department by his University of Florida students, and his Introductory Astronomy courses at Syracuse were cited as ''Recommended Courses'' in Lisa Birnbach's N*ew and Improved College Book* for 1990.

Henry was also well known for his dedication to students and postdocs. He was an exceptionally patient and gentle advisor, never openly critical, and often gave more credit to his students than was strictly necessary. He also took a deep personal interest in his students' welfare; as he told one of them, ''an advisor should spend half of his time as the student's analyst.''

Henry was a model scientist in many ways. It is hard to imagine stellar dynamics without him.

David Merritt
Rochester, NY

Stephen Gottesman
Gainesville, FL

MICHAEL JAMES LEDLOW, 1964 – 2004

Michael James Ledlow died on 5 June 2004 from a large, unsuspected brain tumor. Since 2000 he had been on the scientific staff of the Gemini Observatory in La Serena, Chile, initially as a Science Fellow and then as a tenure-track astronomer.

Michael was born in Bartlesville, Oklahoma on 1 October 1964 to Jerry and Sharon Ledlow. He obtained his Bachelor Degree in astrophysics at the University of Oklahoma in 1987 and attended the University of New Mexico for his graduate work, obtaining his PhD while studying Galaxy Clusters under Frazer Owen in 1994.

From 1995-1997 Michael held a postdoctoral position with Jack Burns at New Mexico State University where he used various astronomical facilities including the VLA and Apache Point Observatory to study distant galaxies. From 1998-2000 Michael rejoined the Physics and Astronomy Department at the University of New Mexico where he was a visiting professor until he moved on to Gemini.

At the Gemini Observatory, Mike shared in the excitement, hard work and many long days and nights associated with bringing on-line a major new astronomical facility and its instrumentation. Following its commissioning he assisted visiting observers, supported and took data for many more remote users via the queue system, and for each he showed the same care and attention to detail evident in his own research to ensure that all got the best possible data.

His research concentrated on the radio and optical properties of galaxy clusters, especially rich Abell clusters such as A2125, on luminous radio galaxies, including the detection of a powerful double radio source in the ″wrong sort of galaxy,″ the spiral system 0313-192, and on EROs (extremely red objects), dusty galaxies barely detectable at optical wavelengths.

Michael thoroughly enjoyed living in Chile and enthusiastically immersed himself in the culture of his surroundings. He and his family were actively involved with the International English Spanish Association in La Serena. He had a wide variety of interests including a wonderfully diverse taste in music and an exceptional talent for home brewing beer.

Mike was one of those rare individuals, enthusiastic and driven by his work at the Observatory as well as by his personal research, and with the skills to deliver in both aspects. His devotion to the Observatory and to research was surpassed only by that for his family. He is survived by his wife Cheryl, their two children Alexandria (″Andrea″) and Abigail (″Abi″), three stepdaughters Mandy, Memoree and Misty and his sister Lisa Gay Gilmore.


Michael Ledlow

Phil Puxley and Randy Grashuis
Gemini Observatory

JEANNETTE VIRGINIA LINCON, 1915-2003

J. (Jeannette) Virginia Lincoln died on 1 August 2003 of natural causes at age 87. She was a pioneer in space weather forecasting and was instrumental in establishing the World Data Center-A for Solar-Terrestrial Physics (WDC-A for STP) at the National Oceanic and Atmospheric Administration's (NOAA) National Geophysical Data Center (NGDC). Lincoln received a U.S. Department of Commerce Gold Medal for Distinguished Service in 1973 for outstanding accomplishments and leadership. She was elected a Fellow of the American Geophysical Union, a Fellow of the American Association for the Advancement of Science, and a Fellow of the Society of Women Engineers. A physicist, she served as Division Chief of the Solar-Terrestrial Physics Division (STPD) and Director of WDC-A for STP from 1966 until her retirement in 1980.

Virginia was born on Labor Day, 7 September 1915, in Ames, Iowa, to Rush B. Lincoln and Jeannette Bartholomew Lincoln. Her father, Rush B. Lincoln (b. 1881, d. 1977 at age

Virginia Lincoln

95), served as a Major General in the U.S. Air Force. He was a direct descendant of the brother of President Abraham Lincoln. Her mother Jeannette Bartholomew Lincoln (d. 1986 at age 104) taught Chemistry at Iowa State University. Her brother, Rush B. Lincoln, Jr. (d. 2002), was five years older. Her grandfather Lincoln fought in the Civil War as a Confederate Captain. Virginia was immersed in military life and continued many contacts and visited military installations throughout her life. Her parents lived with her until their deaths. She enjoyed the perks of being a General's daughter, actively participating in her parent's lives, and served as caregiver in their declining years. Influenced by her Army background, she developed a strong assertive personality and good problem- solving capabilities.

She received a bachelor's degree in physics from Wellesley College in 1936 and a master's degree from Iowa State University in 1938. She was an instructor in household equipment at Iowa State from 1936 to 1942. Electric appliances were new-fangled devices and people had to be educated in their use.

In 1942, Virginia joined the U.S. National Bureau of Standards in Washington, DC, as a physicist in the Interservice Radio Propagation Laboratory (IRPL), working in ionospheric research. In 1946 the Central Radio Propagation Laboratory (CRPL) was formed to centralize research and provide predictions in the field of radio propagation, including investigating solar and geophysical effects and ionospheric data. In 1954 CRPL moved to Boulder, Colorado. Her first job was preparing monthly ionospheric prediction contour maps as a radio weather forecaster. The predictions were used in selecting frequencies for long distance communications. Alan H. Shapley, Department of Terrestrial Magnetism, had contracts with solar observatories to obtain their data, and worked with Lincoln on forecasts. In 1949, Virginia helped create a statistical method for predicting sunspot activity that is still used today in forecasting solar storms that can disrupt radio communication on Earth.

Taking on administrative responsibilities, Virginia was appointed Chief of Radio Warning Services in 1959, the first woman to head a section in the federal bureau. Also in 1959, Lincoln was the only woman in the official U.S. delegation of over 50 scientists to attend a meeting of the International Geophysical Year (IGY) in the former Soviet Union. Using her Russian slides, Virginia gave many talks about the IGY to groups including the Chemical Society banquet, educational associations and women's service clubs. She was part of weekly meetings with Walt Roberts and the High Altitude Observatory (HAO) staff, discussing solar-terrestrial relationships. They developed auroral and cosmic ray indices for the Calendar Records (graphical display of indices and outstanding solar-terrestrial events each day) of the IGY.

In 1966 she gave up forecasting work to devote time to data center work, serving as Director of the WDC-A for STP and the STP Division Chief for NOAA NGDC. She was passionate about the World Data Center system and maintaining data archives for future generations. She would introduce herself as ''I am the World Data Center for Solar-Terrestrial Physics.'' Attending many foreign and U.S. meetings, she constantly searched for new data sets to add to the STP collection.

She retired in 1980 after 38 years of federal service. When she was inducted into the Colorado Women's Hall of Fame in March 2000, she said: ''My work with the World Data Centers introduced me to colleagues worldwide that became a source of much enjoyment, seeing them periodically at the international scientific meetings in Europe, Asia, and Australia.''

She was a past chair of the Denver Section of the Society of Women Engineers and very active in encouraging girls to study math and science. A member of the Association of Federal Professional and Administrative Women (AFPAW) and the Federally Employed Women (FEW), she supported improving the status of women.

Virginia categorized herself as a joiner. She was active in many organizations, achieving life membership in the American Association of University Women (AAUW) and the Young Women's Christian Association (YWCA). In her younger days she was a figure skater and she enjoyed square dancing, playing golf, and traveling. She also enjoyed the arts and held season tickets to the University of Colorado Artist Series, the Denver Center for the Performing Arts, the opera, and the Colorado Music Festival.

She was preceded in death by her parents and her brother Rush. Survivors include a nephew, Rush B. Lincoln III, a niece Deborah Lincoln Niekras, four great nieces and a great nephew. Her memoirs, ''My Busy Life: How I Never

Stopped Enjoying It'' by Jeanette Virginia Lincoln, are available at the Carnegie Library in Boulder, Colorado. Also available are her history of her father ''Rush Blodget Lincoln, My Father – the General'' and a history of her mother's family. Lincoln's legacy in the World Data Center system continues to this day.

Helen E. Coffey
NOAA National Geophysical Data Center

JANET AKYZ MATTEI, 1943–2004

As director of the American Association of Variable Star Observers for thirty years, Janet Mattei led the organization through a series of major improvements and in the process, helped and influenced amateur and professional astronomers around the world. Having successfully tackled many challenges, however, Janet lost her battle with acute myelogenous leukemia on 22 March 2004.

One of five children of Bella and Baruk Akyüz, Janet was born on 2 January 1943 in Bodrum, Turkey and received her pre-collegiate education there. She attended Brandeis University from 1962 until 1965 on a full Wein Scholarship, earning a BA in General Science. After eighteen months of supervising a cardiopulmonary laboratory, in 1967 she returned to Turkey to teach physics and mathematics in a high school, and then entered graduate school at Turkey's Ege University. Janet learned of the summer scholarships available at the Maria Mitchell Observatory on Nantucket, and applied to observatory director Dorrit Hoffleit for the opportunity to come back to the United States and learn about variable stars. That summer (1969) she learned to love variable stars, became acquainted with the AAVSO, and met her future husband, Michael Mattei. In 1970, after she earned her master's degree in astronomy at Ege University, Janet entered the University of Virginia where she earned a second master's degree in 1972 with a thesis on T Tauri stars. After receiving her degree in Virginia, Janet married Mike Mattei and became an assistant to Margaret Mayall at AAVSO headquarters.

When Mayall decided to retire in 1973, the AAVSO Council asked Janet to assume the helm as director of the association. With such a sudden advance in her responsibilities, Janet had to rapidly learn the management side of running the organization as well as keep up with the day-to-day scientific activities – responding to requests for data, recording observations as pencil-points on paper charts, and predicting future maxima of long period variables. She accelerated a ten-year project to digitize all of AAVSO's archived as well as current data, without which a century of AAVSO observations would now be nearly inaccessible.

In the mid-1970s professional interest in the cataclysmic variables began to ramp up. When she received the first requests for an AAVSO visual observing campaign coordinated with observations by orbiting observatories as well as large ground based telescopes, Janet accepted the invitation as both an opportunity and a challenge. AAVSO observers responded marvelously and, coupled with Janet's astute forecasting of when cataclysmic variables were likely to brighten again, the program emerged as one of the major technical successes of her tenure. Many AAVSO members will never

Janet Mattei

forget their excitement when France Córdova came to our Fall meeting in 1978 to announce to the astronomical world that X-rays from SS Cyg had been detected by HEAO-1 on the first occasion after the satellite reached orbit when AAVSO observers reported that the star was brightening to a maximum. It was a moment of tremendous pride for everyone, most of all for Janet. It was a success that was repeated frequently in over six hundred subsequent coordinated observing runs with various satellites. This success greatly increased the impact of AAVSO on current astronomical research, enhanced its reputation, and also provided a more immediate thrill for the observers than the ongoing commitment to monitor slowly varying stars.

The late 1970s and early 1980s were a period of substantial inflation in our nation's economy. Furthermore, staff turnover slowed progress with the data processing work, while observations coming to AAVSO from international variable star organizations and independent observers, especially from behind the iron curtain, were increasing rapidly. Faced with rising costs at the same time additional staff was needed to pursue the data processing problems, Janet reacted characteristically: she began taking night courses in management, data processing, fund raising, and other topics that could help her handle the AAVSO work load more efficiently. Nor was her formal education in astronomy quite complete, for during that difficult period she completed writing her dissertation and earned a PhD in astronomy from Ege University in 1982.

AAVSO's headquarters on Concord Avenue was increasingly crowded and also insecure, as the historical data were stored in a building that was vulnerable to fire. In August 1985 long-term AAVSO secretary and benefactor Clinton Banker Ford (BAAS, 1994:1602) solved these problems by donating a new headquarters building at 25 Birch Street in

Cambridge. Janet managed the move into the AAVSO's present facilities masterfully, and then led planning for a dedication of the building combined with a celebration of the AAVSO's seventy-fifth anniversary. It is a measure of Janet's growth in stature in the professional community that Ricardo Giacconi, then director of the Space Telescope Science Institute, was the keynote speaker for the celebration and it was attended by the leaders of variable star organizations from a number of countries. The meeting marked a major turning point in the affairs of AAVSO as well as in Janet's own outlook. Substantially more confident in her abilities as a manager and leader of the organization, Janet never looked back.

Janet's international contacts, through her active participation in the International Astronomical Union (IAU), led her to participate in 1987 as one of the organizers of an IAU colloquium in Paris on the contribution of amateurs to astronomy, the first of her many later involvements in the field of professional-amateur (Pro-Am) cooperation. During that meeting, the Sociétié Astronomique de France (SAF) honored Janet with their Centennial Award for her leadership in variable star astronomy and within the AAVSO. She received an invitation from the Vereniging voor Sterrenkunde, the variable star observers in Belgium for AAVSO to hold its first European meeting in Brussels in July 1990. The meeting proved a huge success, and was followed in 1997 by a second AAVSO European meeting in Sion, Switzerland and a Pan-Pacific meeting in 2003 in Hawaii. Through Janet's leadership, AAVSO reached out to the observers who were already supporting the association with their observations.

One of Janet's strong interests was in education. Using a grant from the National Science Foundation, she led efforts to create *Hands-On Astrophysics* (HOA) based largely on variable stars and AAVSO data. Though it took several years to develop, HOA became the basis for a number of popular teacher workshops and is sure to lead many high school students into careers in science. Janet also helped many future professionals in astronomy, including Karen Meech and Peter Garnavich, and a few in other areas, by providing opportunities for them to work at headquarters during their studies or during an intermission in their formal schooling.

Janet was active in, and honored by, other professional and amateur organizations. A member of the American Astronomical Society (AAS), she received the AAS's George van Biesbroeck award in 1993, served on the AAS Annenberg Award Committee (1994–1997) and served as the first chair of the AAS Professional Amateur Cooperation Committee. Also in 1993, the Astronomical League with their Leslie Peltier Award honored Janet for her leadership of the AAVSO and contributions to variable star astronomy. Janet was elected a director of the Astronomical Society of the Pacific (ASP) and served six years in that capacity (1994–2000), co-chairing at least one Pro-Am workshop with the ASP. She was a member of three IAU Commissions over her thirty-five years of membership in that organization. In 1995, Janet was honored by the award of the Royal Astronomical Society's Jackson-Gwilt Medal and was the first recipient of the Giovanni Battista Lacchini Award for collaboration with amateur astronomers from Unione Astrofili Italiana. To honor her professional achievements, an asteroid was named for her (11695 Mattei). She always felt that these awards honored not just of her own work, but also the contributions of the members and observers who make up the AAVSO community.

Janet Mattei left a very different AAVSO than the one she took over in 1973. From 150,000 observations arriving annually and being handled on paper, now 500,000 arrive each year and are mostly processed and posted automatically. The association has a substantial endowment and owns its headquarters building in Cambridge, Massachusetts. The historical archive has been put into usable form, following two multi-year investments in digitization and validation. The activities of the AAVSO have been extended to include notifying space and ground observatories that particular objects are erupting and to capturing short-lived gamma ray burst afterglows. The organization's ties to those with similar missions around the world have been strengthened and, increasingly, the AAVSO's International Variable Star Database incorporates their data.

Janet's final illness was followed, through email bulletins, by hundreds of her friends and colleagues around the world. Characteristically, during a remission-and-recovery time between treatments, Janet reached out by phone and email to many of her AAVSO associates and friends, and resumed her habit of sending appropriate cards for special occasions. The more than 200 email ''memoriam'' notes posted on the AAVSO web site after her death show that all who knew her, even if only briefly, considered her a friend, a mentor, or a fine example of a scientist and leader.

Thomas R. Williams
Rice University
Lee Anne Willson
Iowa State University

BEN HAWKINS MOORE, 1921-2003

Ben H. Moore, emeritus professor of physics, astronomy and earth sciences at St. Cloud State University, Minnesota, died 7 November 2003, in South Padre Island, Texas. Ben was born 18 March 1921, in Kansas City, Missouri, to Fraser D. and Cora R. (Hawkins) Moore. Though his parents provided a strong guiding influence on Ben's development, Ben's career was impacted most clearly by his work as a student and research assistant for Allen Basset (Ben's father-in-law) at Park College. This relationship turned Ben's early interest in chemistry and biology toward a focus on physics.

Ben received his undergraduate degree from Park College where he graduated Phi Delta Kappa. He received a MS in physics from Kansas State University. He also did post-masters work at the University of Kansas, the University of Colorado, the University of Washington and Temple University. In addition to his work as a research assistant, Ben taught at Park College as well as Washington Kansas High School, Wyandotte High School, and Kansas City Kansas Junior College before moving to St. Cloud State University in 1960. He retired from this teaching position in May 1982 but remained involved in activities of his department, including some teaching, through most of his years in retirement.

Ben's accomplishments were mainly centered on his teaching. His development of courses and his rapport with students consistently brought praise from both his colleagues and his students. Above all, his work involved innovative development of the curriculum in the sciences at St. Cloud State. Soon after his arrival at the university, Ben took over the fledgling field geology course and continued to shape this offering into a program in earth sciences. The popularity of his classes, which attracted both general students and a growing number of majors, finally enabled the university to establish an earth sciences department in the late 1960's and Ben was the first chair of that department. In the mid-1960's Ben took a leave to study oceanography at the University of Washington. Clearly this field of study is now seen as extremely important, but few institutions in the Midwest were prepared to offer even a single course in oceanography. Ben's idea was to make St. Cloud one of the rare universities with such an emphasis and also to apply the methodology of oceanographers to the study of the great lakes region.

By the end of the 1960's, geologists had become involved with exploration of lunar materials and St. Cloud State University became one of the locations for study of these materials under Ben's direction. This venture into space exploration led Ben back to physics and astronomy and his insights were incorporated into an expanded earth sciences program. He took time at Temple University to study the use of planetarium programs and he also studied at the Adler Planetarium in Chicago. In the 1970's Ben managed the construction of a planetarium at St. Cloud State University making it one of the few such facilities in the upper Midwest. The addition of the planetarium allowed an immediate expansion of interest in astronomy among students and in the mid-1970's Ben became director of the planetarium program in addition to his other teaching and administrative responsibilities. By the time of his retirement, the astronomy major had become the largest offering in the science programs both in terms of majors and general students drawn to the courses.

While Ben's achievements were almost exclusively focused on the development of curricula and programs, he did continue to read extensively and contributed occasional articles and reviews to professional journals. In retirement, this activity continued even more vigorously as he was regularly invited to review manuscripts and write reviews of new materials. His most significant contribution might have been his outreach to the general community. He continued to direct programs at the planetarium after his retirement, especially those aimed at the public schools and the general public. These regularly scheduled programs provided a way for the university and for the science programs to achieve a level of prominence in the community and they opened vistas of wonder for budding scientists in the schools. After his experiences at the Adler Planetarium, he developed a particular presentation on the Star of Bethlehem that he gave not only in St. Cloud but also in Texas where he spent winters in the last few years. His program was designed to highlight the scientific questions that arise when one thinks about the possible explanations of such an event. On the other hand, the popular knowledge of, and interest in, this story became a vehicle for Ben to draw an even greater appreciation for the sciences from public audiences.

Ben married Alice Winifred Bassett in 1943 in Kansas City, Missouri; she died in 1971. A year later he married Marjorie Rotnem who survives him. He is also survived by three sons (John, James and Robert Moore), and one daughter (Donna Habermeyer) from his first marriage as well as Richard and Diane Rotnem from his second marriage; there are seven grandchildren. His devotion to his family was perhaps even more central to his life than his love for teaching and science. He is also survived by a host of friends, colleagues and students who hold him in the highest regard.

In the last few years of his life, Ben took on a project in thinking about the relation between science and religion, partly at my urging. His written comments on this topic are more than two hundred pages. Throughout his career he had fought for ways to be Christian and to be an authentic scientist. This meant, for him, a level of humility for both disciplines as well as clear and reasonable thinking. Among the many other things that Ben's life models for us is this life long passion to be both religious and rigorously scientific at the same time, finding no ultimate conflict in doing that. In my view, his influence on these significant questions remains a lasting legacy of his life's work.

James F. Moore
Valparaiso University

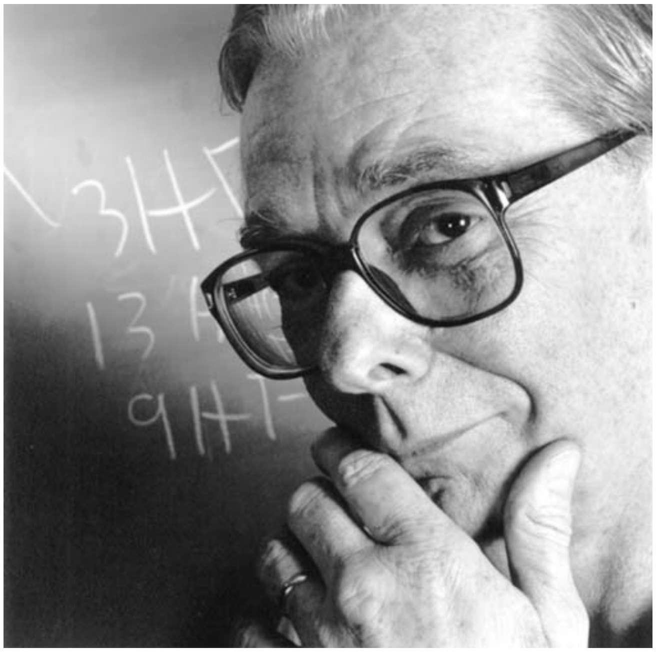
JOHN BEVERLEY OKE, 1928 - 2004

John Beverley (Bev) Oke passed away of heart failure early on 2 March 2004 at his Victoria, B.C. home. Bev's insatiable scientific curiosity led to fundamental contributions in many areas of stellar and extragalactic astronomy, including the development of advanced instrumentation for the largest optical telescopes and the mentoring of scores of grateful students and colleagues.

Bev Oke was born in Sault Ste. Marie, ON, Canada on 23 March 1928, the son of Lyla Parteshuk and the Rev. C. Clare Oke. He entered the University of Toronto in 1945 to study physics with a steadily increasing fraction of astronomy, receiving his BA in 1949. Summer employment at the David Dunlap Observatory (DDO, 1948) and at the Dominion Observatory (Ottawa, 1949, 1950) sealed his interest in astronomy as a career. For his MA thesis (1950, Toronto), performed under theoretician Ralph Williamson, he made interior models of the Sun, and was proud to have proved that the proton-proton cycle was indeed the source of solar energy.

Upon entering Princeton University he worked with Martin Schwarzschild on stellar interiors models and Lyman Spitzer on interstellar lines. A lifelong friendship with Alan Sandage began during Bev's second year while Alan was a post-doc at Princeton. During Bev's third year he spent three months in Pasadena with Lyman obtaining data for his thesis on Of stars. While in Pasadena he began a second life-long collaboration with Jesse Greenstein, an astronomer whose approach to science Bev deeply respected.

In the small field of astronomy in that era, Bev wrote to DDO Director Jack Heard indicating the nearing completion of his PhD studies and his interest in a position. This led to a



John Beverley Oke

lectureship at the University of Toronto (1953-1956), followed by an Assistant Professorship (1956-1958). Bev's interest in instruments began at this time, when he built a device to convert photographic density to intensity, and worked with DDO engineer- machinist Jerry Longworth to implement one of the first two photoelectric scanners ever built. His main interests at the time were the classification of the thousands of stellar spectra in the DDO archives, and studies of Cepheids using his new spectrum scanner. At a Halloween party in 1954 he met Nancy Sparling. Together they initiated a life partnership factually punctuated by their August, 1955 marriage and the arrival of their children, Christopher (1957), Kevin (1958), Jennifer (1961) and Valerie (1966). Their home was notable to all for the deep aura of familial love and joy in the pursuit of knowledge and accomplishments.

In winter 1957-58 Jesse Greenstein invited Bev to join Cal Tech, where he became an Associate Professor (1958) and then Professor (1964); during the period 1970-1978 he was Hale Observatories Director. With the large telescopes at Mount Wilson and Mount Palomar, astronomy there could aspire to be the best in the world, but this required instrumentation of the highest capabilities. Bev soon began to contribute in a major way to their instrumentation excellence following examples established, among others, by Ira Bowen and Horace Babcock. His began by improving the DC amplifiers then in use; constructing a high-spectral-resolution, scanning spectrophotometer; designing vacuum Dewars for astronomical applications; creating pulse counting systems for photoelectric devices; and building the innovative 32-channel spectrum scanner for the Palomar 5-m telescope that was completed in 1968.

Bev built instruments to advance astronomy and to satisfy his wide-ranging curiosity about nature. With the first single-channel spectrum scanner he built at Cal Tech he played a key role in the discovery of the redshift of 3C273. Using his multi-channel spectrometer with students and colleagues, he pursued a highly successful quest to establish accurate spectral-energy distributions for diverse classes of stars and galaxies, based upon rigorous calibration against physical standards. Through this painstaking work he enabled the advances of astronomers worldwide for subsequent generations and extending to the present day. Among his 222 refereed publications, his 1974 paper on absolute spectral-energy distributions for white dwarfs and his 1983 paper with Jim Gunn on secondary standard stars for absolute spectrophotometry led his extraordinary citations. He maintained a career-long interest in the theoretical modeling of stellar atmospheres to help him analyze his lengthy series of observational determinations of absolute stellar fluxes in variable and non-variable stars.

As CCD technologies became practical for real science in the late 1970s, Bev leapt to apply them, publishing in 1977 among the first, if not the first, astronomical spectra obtained with them. Using the new detector technology, he seized the opportunity to design and build a very efficient, low-resolution, double (blue, red) spectrograph for the Cassegrain focus of the 5-m Palomar telescope. It went into operation in 1981 and was still in use (with upgraded detectors) in 2004. When the design and construction of the Keck 10-m Telescope began in the 1980s, Bev applied lessons he had learned from the experiences of the Canada-France-Hawaii Telescope to design the Keck dome, with its many innovations. With Judith Cohen he designed and built the low-resolution imaging spectrograph (LRIS) for the Keck telescopes, which contributed greatly to the impact of that observatory in its early years. LRIS was a logical continuation of the Palomar Double Spectrograph design but had even greater efficiency. They commissioned LRIS on Mauna Kea in 1993, some two years after Bev's early retirement from Cal Tech.

In Fall, 1991 Bev became a visiting worker at the National Research Council Canada's Dominion Astrophysical Observatory in Victoria, B.C., where he remained active until the day of his death. During those years he used LRIS extensively to study the evolution of clusters of galaxies, and actively pursued time- resolved studies of variable stars. At the time of his death, he had resumed efforts to improve aspects of the absolute energy distribution calibrations whose shortcomings he appreciated as only he could. He was also designing spectrographs for the next generation of 20-30-m aperture telescopes as part of Canadian studies for a 20-m telescope and then for the U.S.-Canadian partnership to develop a 30-m telescope.

In retirement he served for a decade as Instrumentation Editor for the *Publications of the Astronomical Society of the Pacific,* enhancing its reputation as a vehicle of choice for disseminating information about developments in astronomical hardware and software. In addition to publishing more than 32 research papers in those same retirement years, he played a leadership role in the design and implementation of the *Center of the Universe* visitor center that opened in 2001 at the DAO.

Bev Oke lived to exceptionally high standards in his scientific work and in his treatment of others. Yet he was a modest, generous and genuinely pleasant man with a deep sense of humor who freely shared his knowledge and enthusiasm: his door was always open to those with a challenging problem. He respected and acknowledged all who contributed to his life in astronomy, whether administrative staff, technician, engineer, student or an astronomical peer. In turn, others documented their appreciation for his support in frequent acknowledgements to him in their papers. He and Nancy raised four exceptional children in a home filled with love, intellectual vitality, music and art, into which they invited countless friends from all regions of the globe. As a visitor to their home, it paid to be Bev's partner rather than his opponent in a game of crokinole. The day before he died, Bev worked on his research at DAO and then returned home, where he repaired a problem on his beloved MG sports car. At the time he died during early-morning darkness on 2 March, the stars fittingly shone brightly in a cloudless sky.

James E. Hesser
Dominion Astrophysical Observatory

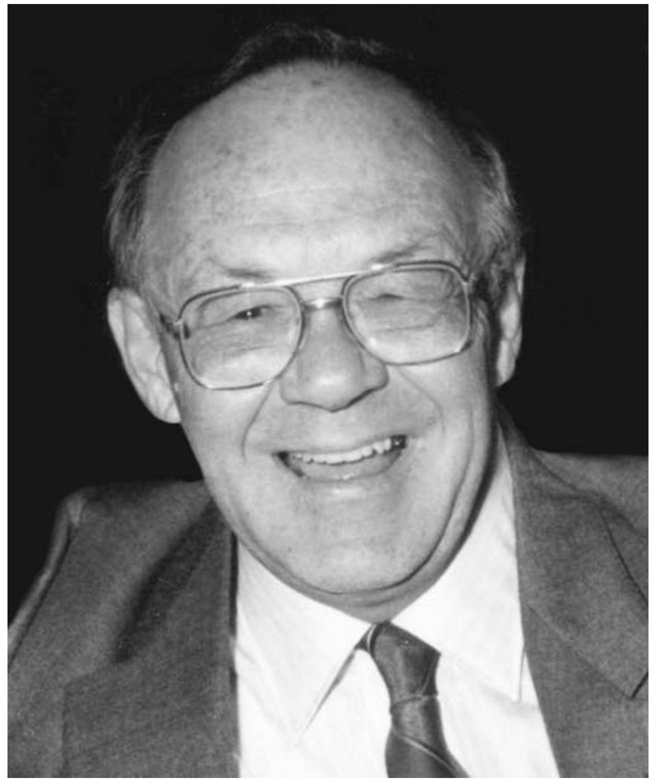
WILLIAM MERZ SINTON, 1925 – 2004

Bill Sinton, one of the pioneers of infrared planetary astronomy, died at his home in Flagstaff, Arizona, on March 16^{th} 2004, at the age of 78.

Bill was born in Baltimore on April 11, 1925. He developed lifelong interests in railroads and radios while still a child, and by age 15 he had already built a shortwave radio receiver and won his ham radio license. His abiding interest in electronic and mechanical devices would serve him well in his professional career. He fought with the 26^{th} Infantry Division in the Second World War and was wounded in France in October 1944. After the war he obtained his bachelor's degree in physics at Johns Hopkins (1949). His doctoral work at the same institution, with John Strong, gave him his first taste of infrared astronomy, including the first measurements of the moon at 1-millimeter wavelength. He obtained his PhD, on the infrared spectrum and temperature of Venus, in 1953.

During a 1-year postdoc at Johns Hopkins he probed the lunar subsurface by observing the cooling of the moon during eclipse at millimeter wavelengths, and observed the diurnal variation in Martian surface temperatures in the 10-micron window. He joined Harvard College Observatory as a research associate and lecturer in 1954, and became interested in the question of life on Mars and the then-plausible possibility that Mars's dark markings were due to vegetation. In 1956, using a monochromator that he built himself, he detected absorptions near 3.4 microns in the Martian spectrum which he attributed to a C-H stretch transition in Martian vegetation. These ''Sinton bands,'' as they came to be known, sparked great interest at the time, and though at least some of the spectral structure was later found to be due to terrestrial HDO, and the presence of abundant organic molecules on the Martian surface was finally ruled out by the Viking landers, some of the spectral features that he detected appear to be intrinsic to Mars and are still not well understood.

In 1957, Bill moved to Lowell Observatory, and spent the next nine years there. He considered these to be the most productive years of his career. In his time at Lowell, he continued his studies of the Moon's thermal emission, and built an infrared Michelson interferometer spectrometer that he put to use in identifying the 3.1-micron water of hydration band on Mars. He also met and married his wife Marge in 1960, and their three sons, Bob, David, and Alan were born during the Flagstaff years.



William Sinton

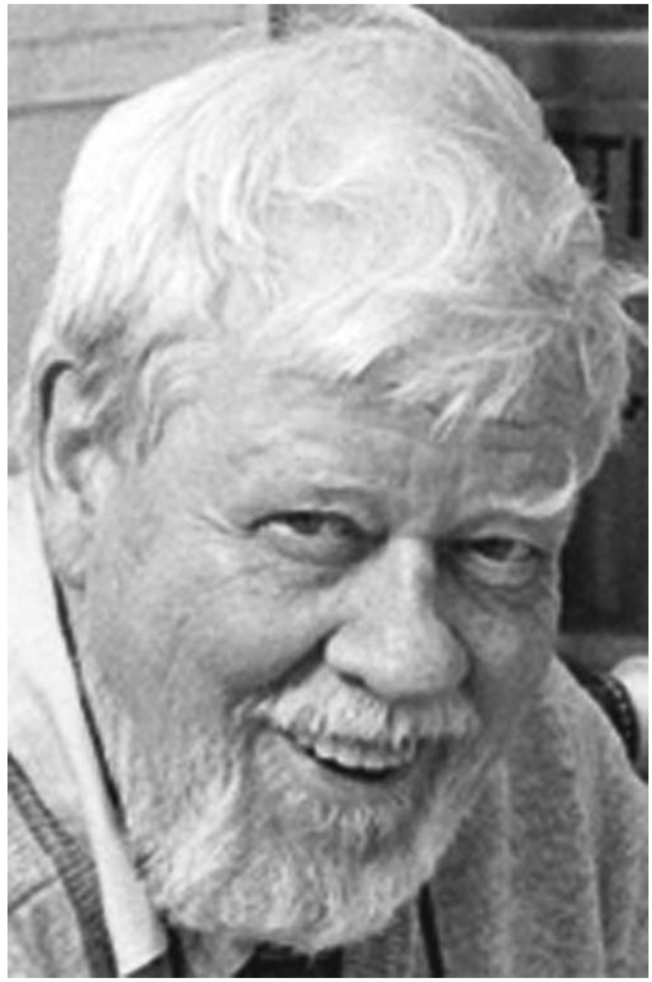
In 1965, Bill was invited by John Jefferies to join the faculty of the University of Hawaii, and to help in the development of the fledgling Mauna Kea Observatory. His work on the design the 88-inch telescope on Mauna Kea, the cornerstone of the observatory, included designing its telescope control system, making it one of the first computer-controlled optical telescopes. His scientific work at the Institute for Astronomy included continued studies of Mars, with his PhD student Terry Martin, as well as the infrared spectrum of Uranus and Neptune. He sometimes translated his pseudocolored maps of the thermal emission from the planets, pixel by pixel, into the unique medium of stained glass. In 1979, following the discovery of Io's volcanoes by Voyager, he obtained some of the first ground-based observations of the infrared thermal emission from the volcanoes. He devoted the last decade of his career to the ground-based study of Io's volcanoes, working to characterize their time variability and developing techniques to identify their locations on Io. He was one of the founding members of the International Jupiter Watch in 1987, and was the first leader of its Satellite Discipline.

When he retired from the University of Hawaii in 1990, he and Marge returned to Flagstaff, and he renewed his association with Lowell Observatory as an adjunct astronomer. He built a miniature steam-powered railroad around his house, to the delight of the neighborhood children who would get to ride on it on special occasions. In 1993 he was diagnosed with ALS (Lou Gehrig's disease), and was confined to a wheelchair shortly afterwards, but he continued to attend scientific meetings, and to contribute to Lowell Observatory as a member of its Advisory Board, till shortly before his death. In 2002 he published an autobiography, *I Choose to Live*, which described his life and his battle with ALS. Because he could no longer use a keyboard he wrote the entire book using voice-recognition software- a testament to his determination to keep as active and productive as possible despite the encroachments of the disease.

We remember Bill as a warm, gentle, and enthusiastic man with an encyclopedic knowledge of all things infrared. He had a love of mechanical gadgets of all types, whether he was designing plumbing for a He^3 cooled germanium bolometer or for a model steam engine. He is greatly missed by his family, friends, and former colleagues.

Within two weeks of Bill's death came the announcement that CH_4 gas had been discovered on Mars by the Mars Express spacecraft, confirming similar results from ground-based telescopes. The methane, touted as possible evidence for extant Martian life, was discovered via its 3.3-micron C-H stretch band. This is essentially the same vibrational transition, potentially carrying the same hints of living Martian organisms, which Bill thought he had seen on Mars 45 years earlier. So while Bill's initial conclusion that Mars is covered with extensive vegetation turned out to be wrong, his insight that the 3-micron region, with its telltale signature of carbon-hydrogen bonds, was the best place to search for evidence of life on our sister world, may have been right all along.

John Spencer
Lowell Observatory



Robert Walker

ROBERT MOWBRAY WALKER, 1929 – 2004

Robert M. Walker, PhD, Professor of Physics in Arts & Sciences and a faculty fellow of the McDonnell Center for the Space Sciences, died of stomach cancer Thursday, 12 February 2004, in Brussels, Belgium. He was 75. Walker worked on the frontiers of space research for more than four decades.

Robert Walker was born in Philadelphia on 6 February 1929. His mother was Dorothy Potter and he considered Roger Potter his father though he was not his biological father. His early years were spent in New York City and in upstate New York. He attended the Bronx High School of Science, earned his BS in physics from Union College and in 1954, he received his PhD in particle physics from Yale University. He subsequently joined the General Electric Laboratory in Schenectady, New York where he studied the radiation effects in solids. His work on defects in irradiated copper is still regarded as the definitive work on the topic. In the early 1960s, Walker's discovery of fossil nuclear particle tracks in minerals was instrumental to new developments in geo-chronology and cosmic ray physics. In particular, his discovery of tracks from nuclei heavier than iron opened a new frontier of cosmic ray physics. He subsequently pioneered the use of plastics to detect and count such nuclei in cosmic ray balloon flights.

Beginning in 1966, when he moved to Washington University and became the first McDonnell Professor of Physics, his research interests turned more toward space physics. He was the inaugural director of the McDonnell Center, which was established in 1975 by a gift from aerospace pioneer James S. McDonnell.

Walker was a member of the NASA committee that allocated samples of the first returned lunar materials, and his laboratory led the way in deciphering their record of lunar, solar system and galactic evolution. Together with Ghislaine Crozaz and other colleagues, Walker made path breaking laboratory studies of the first moon rocks revealing the history of solar radiation and cosmic rays within these samples. He and Dr. Crozaz were married in 1973. In the past two decades, he was a world leader of microanalytical studies of tiny grains preserved for eons in meteorites, culminating in their identification as stardust. More recent achievements include the design of micrometeorite capture cells that were flown aboard NASA's Long Duration Exposure Facility; verification of the extraterrestrial origin of dust particles collected in the upper atmosphere; and the successful search for interstellar grains in meteorites.

″Bob was such a dominant force for excellence in our department and the University over so many years, it is hard to grasp that he is gone,″ said John W. Clark, PhD, chair of physics, the Wayman Crow Professor and a faculty fellow of the McDonnell Center. ″His passion for life and science was an inspiration to us all, and his legacy will endure in the work of his many colleagues and the extended family of his former students.″

Walker led the McDonnell Center, which includes one of the world's largest research groups dedicated to the search for and investigation of extraterrestrial materials, until 1999. ''Washington University would be a lesser institution without the contributions of Bob Walker,″ said William H. Danforth, chancellor emeritus and vice chairman of the Board of Trustees. ″He gave us inspiration, enthusiasm, great science and visionary leadership. He built the strength of the McDonnell Center for the Space Sciences. He convinced others of the potential for the modern Department of Earth and Planetary Sciences. He had always the respect and affection of us all.″

The last two decades of Walker's career were driven by his remarkable vision and his excitement at the prospect of profound discovery. His recognition of the potential importance of the ion microprobe for making isotopic measurements on microscopic samples, and his acquisition in 1982 of a state-of-the-art instrument for the University, led directly to a series of spectacular results. Chief among these was the identification and characterization of stellar condensates in meteorites, which opened a window into stellar evolution and the creation of the heavier elements.

Always in pursuit of more powerful ways to analyze small amounts of material, Walker devoted the last years of his life to the implementation of nanoscale secondary-ion mass spectrometry (NanoSIMS) promoting the development, acquisition and application of the most advanced instrument of its kind. This effort was rewarded with the discovery, which he had forecast years earlier, of presolar silicate grains in interplanetary dust particles.

The Robert M. Walker Symposium at the University in March 2003 honored his contributions and achievements. He was elected to the National Academy of Sciences in 1973. Among his other honors are the E.O. Lawrence Memorial Award of the U.S. Atomic Energy Commission, the J. Lawrence Smith medal of the National Academy of Sciences, the Leonard medal of the Meteoritical Society and the Antarctic Service Medal. He received honorary doctorates from Union College (1967), the French University of Clermont-Ferrand (1975) and Washington University (2004). He was also one of the founders, and first president, of VITA (Volunteers in Technical Assistance), an organization that provides technological expertise to third world countries.

Walker and his wife maintained a residence in St. Louis County but in 2001, Bob became a part time visiting professor at the University of Brussels. It was in Brussels that his fatal illness was correctly diagnosed. In addition to his wife, Walker is survived by his sons, Eric and Mark Walker; and three grandchildren. His most important legacy will remain the sizable number of students, postdocs, and colleagues within the meteoritic and cosmochemist communities that he mentored and inspired.

Portions of this obituary are based upon one given in the on-line *Record* of Washington University and another published by Floss, Sandford and Zinner in *Meteoritics and Planetary Science* (39:1409-1411, 2004).

Neil Schoenherr
Washington University in St. Louis

JAMES ADOLPH WESTPHAL, 1930 – 2004

James A. Westphal died September 8, 2004. He had battled a neurological disease related to Alzheimer's for the past year. He was 74.

James A. Westphal was born in Dubuque, Iowa, on June 13, 1930. He was raised in Tulsa, Oklahoma, and in Little Rock, Arkansas. Westphal earned his bachelor's degree in physics from the University of Tulsa in 1954, a year after he went to work as geophysical research group leader at Sinclair Research Lab in Tulsa. Westphal first got into the business of scientific instrumentation right after high school, when he did well-logging in Texas and Gulf Coast oil fields. In fact, his work at Sinclair Research Labs involved devising unorthodox methods for oil discovery; one of his discoveries of a new way of processing seismic data first brought him to the attention of Caltech professor Hewitt Dix, who is often considered the father of exploration geophysics.

Westphal arrived at Caltech initially on a four-month leave of absence to devise a data processor for Dix, but never left. He discovered that the academic freedom individual professors enjoy was amenable to his own predilections, so he soon began branching out to other areas of scientific investigation at Caltech. Before long, he had teamed up with Bruce Murray to do thermal infrared scans of the moon in order to see if humans could even walk on the lunar surface without sinking into the dusty soil. Westphal and Murray's work showed that rocky areas could be identified with the thermal imaging, which in turn led to the inference that the Apollo astronauts could safely walk on the soil without sinking. Westphal and Murray also teamed up to do the first infrared imaging of Venus and Jupiter.

Other projects at Caltech led to Westphal's being hired on permanently by Bob Sharp, who at the time was the geology division chairman. In the following years, Westphal involved himself in novel ways of studying volcanism in Hawaii and Mount St. Helens. He invented a simple and very sensitive tilt meter that allowed them to measure the volcano's expansion and help predict upcoming eruptions. Westphal also designed a way of creating a high-pressure aquarium for studies of deep-ocean animals as well as instruments for tracking glacial ice flows and capturing starlight.

Caltech astronomers were pleased to discover that Westphal had an idea for an infrared camera for the historic 200-inch Hale Telescope--at the time the largest optical telescope in the world--that could measure the radiance of galaxies with greater precision and capture fainter galaxies than possible up to that time. He built various other instruments for the Hale Telescope, including a Silicon Intensified Target camera, which was a sort of transitional device between the photographic emulsion plates of the day and modern charged-coupled devices (CCDs) and which produced digital pictures with unparalleled clarity. The instrument is now in the Smithsonian's National Air and Space Museum's collection.

James Westphal

Westphal and Jim Gunn (now at Princeton) recognized early that CCDs would revolutionize astronomy, and in the process of obtaining them for Palomar, Westphal and Gunn decided to put a team of astronomers together and design a CCD camera for use on the Hubble Space Telescope. Westphal was named principal investigator of the proposal and Jim Gunn was his deputy. They teamed with JPL to design the main camera for Hubble Space Telescope. (The Wide-Field / Planetary Camera), which proved to be an enormously successful part of the telescope's scientific mission. Westphal's research came up with a CCD coating that absorbed the UV photons and fluoresced back in the visible thus allowing the instrument to be used in the UV (The engineers dubbed the coating ''mouse milk''). He didn't reveal the composition of the coating until NASA announced that the Caltech/JPL proposal was selected to provide the WF/PC Investigation. During the Hubble first light operations Jim had to diagnose the spherical aberration in the main 2.4 meter mirror, which caused the Hubble's initial focusing problems, while being photographed in real time by all the press cameras.

A straight forward fix was devised for the WFPCII camera to bring the images into sharp focus. Once the repaired camera and the Hubble Space Telescope were safely in orbit, Westphal and his collaborators began receiving data on a regular basis. One of the early images of distant galaxies provided especially compelling evidence for the phenomenon known as gravitational lensing. ″When this picture came in,″ Westphal said in a 1995 interview for Caltech's Engineering and Science magazine, ''I put it under [Caltech physicist] Kip Thorne's door with a note saying, if you ever have any doubt about gravitational lenses, here's your proof.''

He was a member of the American Astronomical Society and served as the chairman of the Division for Planetary Sciences in 1979-1980. In 1991 Westphal received a MacArthur Fellowship. Already a tenured faculty member and the author of scores of refereed journal articles, and the creator of 15 patented inventions, Westphal was named director of Palomar Observatory in 1995 and served for three years. This assignment included being Caltech's representative to the Cara Board (which managed the KECK telescope).

After lowering one of his custom-designed instruments into Old Faithful at Yellowstone National Park to study the geyser's cycling mechanism, he published a paper with Caltech graduate, Sue Kieffer, in 1997. The work, which received a good deal of media attention, confirmed previous assumptions about the geyser and also uncovered new details about the eruption cycle.

Westphal took Caltech emeritus status in 1998, but remained active in research endeavors until his bout with this illness.

Surviving Jim are his wife, Jean Westphal of Altadena; a son, Andrew Westphal, a daughter-in- law, Kim Taylor, and two granddaughters, Theresa and Laura Westphal, all of Richmond, California; two stepdaughters, Robin Stroll of Agoura Hills, California and Susan Stroll of Eagle Rock, California; and an uncle, Eddy Westphal of Indiana.

A portion of this obituary was taken from a tribute by Robert Tindol published September 14, 2004 in an electronic Caltech Newsletter.

G. Edward Danielson
Caltech, Jet Propulsion Laboratory

FRED LAWRENCE WHIPPLE, 1906 – 2004

Fred Whipple, one of the founding fathers of planetary science, died on August 30, 2004 just two months shy of his 98^{th} birthday. The breadth of Fred's published research from 1927 through 2000 is quite extraordinary. Although his collected works were published in two massive volumes in 1972, shortly before his retirement, Fred's research contributions continued for another three decades - and another volume is planned.

Fred Lawrence Whipple was born on November 5, 1906 on a farm in Red Oak Iowa. His parents were Harry Lawrence and Celestia (MacFarl) Whipple. At the age of fifteen, the Whipple family moved to California where Fred studied mathematics at Occidental College and the University of California at Los Angeles. As a graduate student at the University of California at Berkeley in 1930, he was one of the first to compute an orbit for the newly discovered planet Pluto. Upon receiving his PhD in 1931, he joined the staff of the Harvard College Observatory. He was Chairman of the Harvard Department of Astronomy (1949 – 1956), Director or the Smithsonian Astrophysical Observatory (1955 – 1973), Phillips Professor of Astronomy (1968 – 1977) and Emeritus Phillips Professor of astronomy (1977 – 2004). In 1928 he married Dorothy Woods and their son, Earle Raymond, survives him. The marriage ended in divorce in 1935. Eleven years later, he married Babette F. Samelson and she too survives him, as do their two daughters Laura and (Dorothy) Sandra.

Fred Whipple

Shortly after arriving at Harvard in the early 1930's, Fred developed a photographic tracking network to determine meteor trajectories from simultaneous observations from two or more stations. The photographic trails, chopped by a rotating shutter, allowed their orbits in space to be determined accurately. With the strong involvement of Richard McCrosky and others, he concluded in the early 1960's that most of these meteors were on comet-like orbits and less than 1% of the naked eye, sporadic meteors could be traced to an origin outside the solar system. To fill the daytime gap when meteors could not be photographed, Fred organized a program for the radio detection of these objects. With the launch of Sputnik in October 1957, Whipple's visual network of amateur astronomers (Moon watch) was already in place to follow its progress and later on he developed an optical tracking system for meteors and artificial satellites using wide field, Baker-Nunn cameras. This latter system proved so successful that the precision tracking of these satellites could be used to model the Earth's shape and density variations from the observed gravitational effects upon these satellite orbits. He once noted that the highlight of his career was having his family and parents present at the White House while he received the President's Award for Distinguished Public Service from John F. Kennedy for this work.

His seminal works in 1950-51 on the icy conglomerate model for the cometary nucleus prompted a complete paradigm switch. Until then, the current consensus model for a comet was a flying cloud of particles; it had been so since the second half of the nineteenth century when comets were identified with meteor showers. He envisaged the cometary nucleus as a conglomerate of ices (mostly water, ammonia, methane, carbon dioxide and carbon monoxide ices) embedded within, and covered over with, a nonvolatile matrix of meteoric material. Part of his rationale for developing this ''dirty snowball'' model for the cometary nucleus was to provide an explanation of the so-called nongravitational forces acting upon comets. The rocket-like thrusting of a comet when the ices vaporize near the sun introduced a small, but noticeable, thrust on the comet itself and when this effect was properly modeled, the motions of active comets could be predicted far more accurately. Subsequent spacecraft ultraviolet observations showing enormous cometary hydrogen atmospheres confirmed that the major cometary ice was likely to be water. The 1986 Giotto spacecraft images, revealing a solid cometary nucleus (albeit far blacker than most had predicted), were a dramatic confirmation of Whipple's model -- though in truth few really expected otherwise at the time.

In 1942-1946, he led an effort to develop and implement strips of reflective aluminum (i.e., chaff) to confuse enemy radars in World War II. In 1948, he received a certificate of merit for this work from President Harry S. Truman. Eleven years before the launch of the first artificial satellite in 1957, he developed what is now generally termed the Whipple Shield; a thin outer metallic layer stands out from a spacecraft and protects it from high-speed interplanetary dust particles. While particles hitting this outside thin layer would penetrate, they would also vaporize, and in so doing, the resultant debris would disperse and lack the energy to penetrate the main spacecraft skin. This design was used to successfully protect the Stardust spacecraft from cometary dust particles when the spacecraft flew rapidly past comet Tempel 1 in January 2004. He also made significant contributions to fields as diverse as meteor astronomy, satellite tracking, variable stars, supernovae, stellar evolution, astronomical instrumentation and radio astronomy. Along with his colleagues Willy Ley, Wernher von Braun and others, Fred wrote and consulted for a series of very popular articles in Collier's magazine in the early 1950's and these articles, along with earlier lectures at New York's Hayden Planetarium, helped spark the U.S. involvement in space exploration. Of these early beginnings of space exploration, Fred wrote in 1972 ''it was no easy task to convince people that man could really go into empty space beyond the Earth's atmosphere, and even beyond the Earth's tenacious gravitational grasp. On looking back over these years, I am still surprised that we succeeded in convincing them.''

Fred was responsible for initiating the Smithsonian Astrophysical Observatory's observatory on Mt. Hopkins near Tucson Arizona and he was active in the design of the multi-mirror telescope that was in operation until 1999, when a

6.5-meter single mirror telescope replaced it. In 1981, the observatory was renamed the Fred Lawrence Whipple Observatory. Fred was successful as both a manager of large science enterprises and as a researcher. He once told me that one of his secrets for doing both management and science simultaneously involved his spending some mornings in a room adjacent to his office doing research. His secretary was asked to (correctly) notify morning callers that Dr. Whipple was not in his office at the moment and could he return the call later on in the day. When asked the secret of his longevity at his 90^{th} birthday party, he noted, ''you've got to start early.'' Fortunately for Planetary Science, he did start early - and he stayed late. Until he reached 90 years of age, he rode his bicycle to the office most every day and those days when he drove to work, his car was easy to identify from the single word ''comets'' on his license plate.

Fred Whipple was awarded seven honorary degrees and included among his many tributes are a certificate of Merit from President Truman (1948), the J. Lawrence Smith Medal of the National Academy of Sciences (1949), a Distinguished Federal Civilian Service Award (1963), the Frederick C. Leonard Memorial Medal of the Meteoritical Society (1970), the Gold Medal of the Royal Society (1983), the Bruce Medal of the Astronomical Society of the Pacific (1986), and the Henry Norris Russell Lectureship of the American Astronomical Society (1987). He also discovered six new comets and discovered and named an asteroid (1252 Celestia) after his mother. Asteroid 1940 was renamed (1940) Whipple to honor his professional achievements.

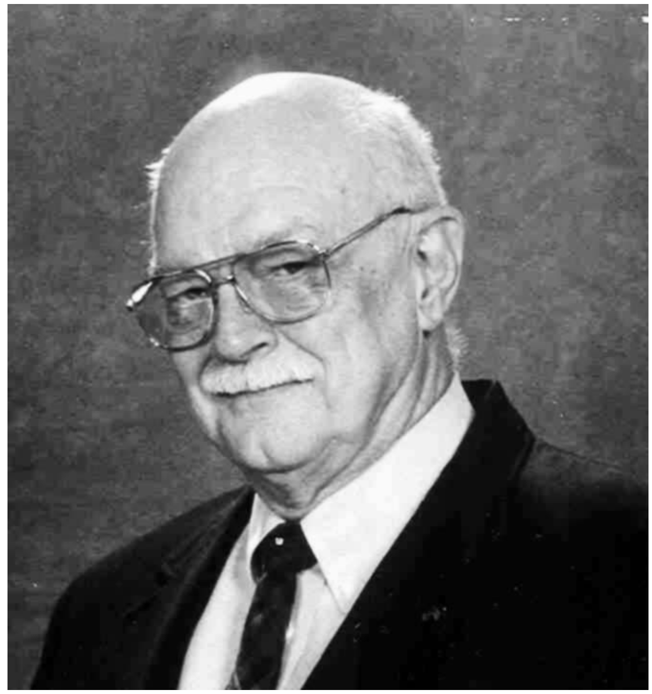
Fred Whipple was a Harvard Professor, director of the Smithsonian Astrophysical Observatory, a Presidential medallist and his name is synonymous with comets. He was one of the few great innovative thinkers in twentieth century planetary science. Yet through it all, he remained just Fred to all who knew him. Whether you were a young student or a distinguished internationally recognized scientist, this gentleman treated everyone with the same kindness and respect. The entire planetary science community has benefited immeasurably from his wide-ranging insights; we've lost a creative scientist and a kind mentor - but he remains a superb role model for us all.

This obituary is based on one by D.K. Yeomans and J. Veverka that appeared in *Nature* (4 Nov. 2004, vol. 432, p. 31).

Photograph provided by J. Veverka.

Donald K. Yeomans
Jet Propulsion Laboratory

RAYMOND EDWIN WHITE, JR., 1933 - 2004



Ray White

Raymond E. White, Jr., died unexpectedly at his home, in the early morning hours of October 12, 2004. Death appears to have been caused by severe diabetic shock. He retired from the Department of Astronomy/Steward Observatory in July 1999 with the title of University Distinguished Professor, after serving on the faculty of this institution for over 35 years.

He was born in Freeport, Illinois, on 6 May 1933, to Beatrice and Raymond E, Sr. –the latter being a career soldier in the US Army. Ray's early schooling took place in Illinois, New Jersey, Germany and Switzerland, following his father's assignments. He obtained a bachelors degree from the University of Illinois in 1955. Next Ray enlisted in the US Army, but quickly was enrolled in Officer Candidate School. He then served as lst Lt. in the US Army Corps of Engineers. Although military affairs remained a lifelong interest, and he was a member of the Company of Military Historians, Ray decided after three years to return to academia. He entered the astronomy PhD program at the University of Illinois in 1958. His PhD dissertation was supervised by Ivan R. King. Ray accepted a faculty position at the University of Arizona in 1964.

First and foremost, Ray White was known at Arizona as an excellent teacher, revered by a large number of former students. When the astronomy major program was begun in 1967, Ray was one of three, original, major advisors. Over the next three decades, he was a leader at the University level in reforming the undergraduate program and courses. He was selected Outstanding University Faculty Member in April 1989 and he served as one of a handful of professors who are Faculty Fellows. These Fellows devote untold hundreds of hours as part-time residents at student dormitories, to give students a friendly face to address their problems. In 1995, Ray was among the first group of faculty to be recognized as University Distinguished Professors. In the year of his retirement, 1999, University President Manuel Pachecho recognized Ray's extensive contributions by asking him to serve as Master of Ceremonies at the University commencement.

Ray White's research career was not as extensive as his teaching activities, but it was creative. His original specialty was globular star clusters and classes of variable stars within them. He made several catalogs of star clusters and associations, measured the exact centers, the axial ratios and the orientations of around 100 Galactic globular clusters. Certainly, Ray's greatest love in research, especially in later years, was archaeoastronomy. He studied the evidence for astronomical observations of the Sun, Moon and stars from the mound sites of the prehistoric Hohokam inhabitants of the Salt River Valley of Arizona. He was best known for his studies of the Inkaic people of the pre-Columbian, Peruvian Andes. Most of this research involved the grand Machu Picchu site, where he showed (with David Dearborn) that the central tower (the ″Torreon″) certainly had been used as an Observatory. They also discovered a separate, solstice observatory and named it Intimachay.

Characteristically, Ray combined much of his archaeoastronomy research interests with the involvement of undergraduate students and adults through the Earthwatch program in field trips to Machu Picchu. With a Professor in the humanities who was also well known at the University of Arizona, Donna Swaim, Ray introduced a group of undergraduates in summer classes to several archaeoastronomy sites in such countries as Ireland and the British isles. Of course they also gave on-site lectures at art museums, and sites of historical and cultural interest.

Like many astronomers, Ray was well traveled. He had sabbaticals at the University of Cambridge in 1980, and at the Dublin Institute of Advanced Study (Dunsink Observatory), Ireland, in 1996-97. The latter was funded by his winning a Fulbright Fellowship, which enabled him to further his studies of the Celtic astronomical traditions. Earlier in 1971-72, Ray served as Program Officer for Stars and

Stellar Evolution in the Astronomy Section of the National Science Foundation.

Ray was one of the three ″originators″ of ″The Inspiration of Astronomical Phenomena″ (INSAP) Conferences. These conferences provide scholarly discussions on the many and variegated cultural impacts of the perceptions about the day- and night-time sky, thus providing a forum for a broad sampling of artists, historians, philosophers, and scientists to get together, compare notes, and ask questions of one another. The INSAP Conferences have taken place near Castel Gandolfo Italy, on the island of Malta, near Palermo Italy, and at Oxford University in England.

Ray's scholarship also was manifest in his activities as editor. For some years in the 1990s, he edited two astronomy journals, *The Astronomy Quarterly* and *Vistas in Astronomy.*

Raymond E. White, Jr., is survived by his wife Ruby E. (nee Fisk), his high school sweetheart at Heidelberg High in Germany. Their children include Raymond E. White III (Professor of Physics and Astronomy at the University of Alabama, Tuscaloosa), Kathleen M. (White) Wade, and Kevin D. White. Ray was proud of two beautiful granddaughters, Charlotte R. Wade and Sarah E. Wade.

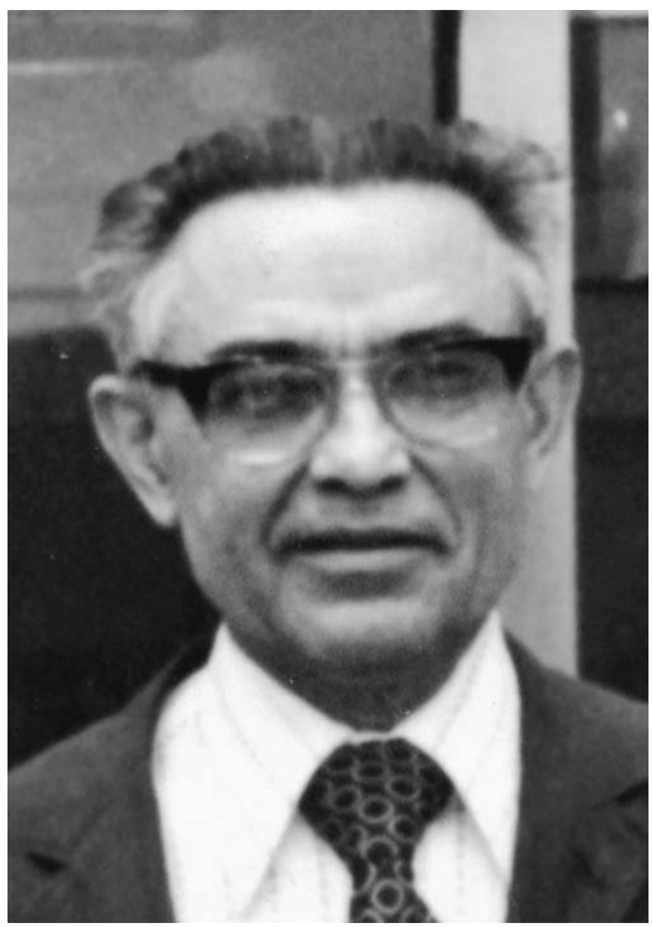
Ray was proud of his early role with Steward Observatory Director Bart Bok in the commissioning of the ″90-inch″ reflector at the University of Arizona site on Kitt Peak in 1969. He built the direct camera, and was invited by his close friend Bok to share the ″first light″ of this telescope, now renamed the Bok 2.3-m telescope. When Professor Bok passed away, the astronomy magazine *Sky & Telescope* invited Ray to write an article which was entitled ″Bart J. Bok (1906-83): Personal Memoir from a Grandson.″ (Bok mentored Ivan R. King, who was Ray's thesis advisor.) In his concluding remarks, Ray wrote, ″The aspect of Bart J. Bok I will miss the most is his exuberance for the *art* of astronomy.″ We will also miss greatly this aspect of Raymond E. White, Jr.

James Liebert
University of Arizona

ROMUALD ZALUBAS, 1911-2003

Romuald Zalubas, a long-time member of the Atomic Spectroscopy Group of the National Institute of Standards and Technology, died of a stroke on June 27, 2003.

Romuald was born in Pandelys, Lithuania in 1911. He studied mathematics and physics at the University of Kaunas, Lithuania, earning a master's degree there in 1936. He then became an assistant at the Astronomical Observatory of Vilnius and an inspector at the Trade Teacher's Institute. Near the end of the Second World War, with the coming communist takeover of Lithuania, he and his wife and young son fled to Germany, where he became director of a high school for Lithuanian refugees. In 1949 he emigrated to the U.S., first lecturing in mathematics and physics in Nazareth College in Rochester, N.Y. and then at Georgetown University in Washington, D.C. In 1955 he was awarded a PhD Degree in astrophysics from Georgetown. His thesis was entitled *''An Investigation of Faint Lines in the Solar Spectrum Between 5000 Å and 6000 Å.''*



Romuald Zalabuas

After completing his PhD degree, Romuald came to the National Bureau of Standards (NBS), now the National Institute of Standards and Technology (NIST). His research at NBS centered on the observation and analysis of complex atomic spectra. He measured and analyzed the spectra of neutral and singly ionized thorium, and helped establish standard wavelengths in these spectra that served to calibrate spectra of high-resolution spectrometers for many years. His research also included work on the analysis of neutral praseodymium and five-times ionized yttrium, as well as several data compilations. His experimental work entailed photographing spectra having thousands of lines with high-resolution spectrometers. Often the spectra were excited in a magnetic field. This provided information about the J-values and Landé g-values of the combining levels. When all of this information was completed, mainframe computers were used to try to break the code of the meaning of these data to deduce the energy levels that give rise to the spectra. This is a time consuming process that requires extreme patience as well as confidence that all of this work will lead to an understandable energy level structure for the atom. The investigation of a single atom might take two, three, or more years. Romus, as he was normally called, indeed had the personal attributes to be successful at this challenging enterprise.

Of all his publications, Romus was probably best known for the major compilation ''*Atomic Energy Levels-The Rare Earth Elements,*'' published in 1978 in collaboration with William Martin and Lucy Hagan. This 411 page volume completed the NBS series of four volumes on atomic energy levels. Charlotte Moore Sitterly published the first three volumes, Atomic Energy Levels as Derived from the Analyses of Optical Spectra, in 1949, 1952, and 1958. The rare earth volume contains energy level data for 66 different rare earth atoms and ions.

Romus was a member of the American Astronomical Society, Sigma Xi, and the Lithuanian American Catholic Academy of Sciences. He was a fellow of the Optical Society of America and the American Association for the Advancement of Science. He retired from NBS in 1981, but continued on as Guest Researcher working on data compilations until 1987.

In the Atomic Spectroscopy Group, Romus was well known for his strong anticommunist views and his dry wit. He was generous in helping others with their research. He enjoyed mentoring summer students and giving fatherly advice to younger members of the Group. Romus was an expert at fabricating electrodeless discharge lamps, and made many lamps for himself and others as well. He donated quite a few of his lamps to other laboratories and observatories for use as a source of wavelength standards.

Romus was especially proud of the new home in Silver Spring that he and his wife, Alexandra, and son, Paul, moved to in 1963. To him it signified how much he had achieved after coming to the U.S. with nearly nothing to his name. Most of his leisure time was spent on the plants and garden for this house. Much of the social life of the Atomic Spectroscopy Group at that time revolved around gatherings that he and Alexandra held in their home. Romus also took great pleasure in following the activities of his three grandchildren, Mark, Eugene, and Lara, with whom he was very close.

Joseph Reader
National Institute of Standards and Technology