lysozyme, in *Biopolymers* in 1979. He later contributed to the observation of low-lying phonons in oligonucleotides. He insisted on constructing a simplified but useful model of DNA in deciding on which experiment to focus.

Shortly after the "Woodstock of Physics" at the 1987 March meeting of the American Physical Society, Ludwig began a detailed study of the optical properties of the first high-T_c superconductor YBaCuO. His spectroscopy group and coworkers made difficult low-temperature reflection measurements on world-class samples of high-T_c superconductor (single crystals, ceramics, and thin films), some of which were made in house. His publications on phonon anomalies and the superconducting gap have been widely read and cited. Later, he started a very fruitful collaboration with the theory group at Los Alamos National Laboratory.

Ludwig loved physics and the fine arts. Franz Schubert's string quartet in D Minor (*Death and the Maiden*) was one of his favorite pieces. His great mentorship of a myriad of students, postdoctoral fellows, and resident and visiting scientists lives on as his greatest legacy. Although, on first impression, Ludwig had a reserved and formal presence, he was one of the few prominent German scientists of his generation to insist that his colleagues use the informal pronoun when addressing him. But this sliver of a fault line in a reserved exterior was only the barest indication of a finely cultivated and delightfully engaging sense of humor.

Ludwig's son, Reinhard Genzel, has continued in his father's footsteps. A director at the Max Planck Institute for Extraterrestrial Research, Garching, Germany, and a professor of physics at the University of California, Berkeley, Reinhard used the infrared techniques developed by his father to probe the existence of black holes.

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Jesse Leonard Greenstein

Jesse Leonard Greenstein, a pioneering astrophysicist and founder of Caltech's astronomy program, died on 21 October 2002 in Arcadia, California, three days after breaking his hip in a fall.


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Jesse Leonard Greenstein

Jesse was born on 15 October 1909 in New York City into a typical prosperous, middle-class, Jewish family. He received his first telescope at age 8, and his family provided a variety of instruments with which he conducted experiments at home, especially in spectroscopy. At age 15, he entered Harvard University, where he received his AB in astronomy in 1929. For the next four years, he worked to save his father's real estate business during the Great Depression.

As a Harvard undergraduate, he had taken courses primarily in classical astronomy, but by the time he enrolled as a graduate student, astrophysics was developing and he was much influenced by Donald H. Menzel and Cecilia Payne. His PhD thesis, supervised by Menzel, involved calculating the absorption and scattering processes for various possible sources of interstellar absorption and reddening. He earned his PhD in 1937.

Jesse then began a two-year postdoctoral fellowship at the University of Chicago's Yerkes Observatory, where Otto Struve had assembled a staff of top-notch astronomers, including theoreticians. By arranging for the use of the 82-inch telescope at the McDonald Observatory, Struve gave his observational astronomers a chance at "big time" research, which until that time had been dominated by the Mount Wilson Observatory staff. With Louis Henyey, Jesse wrote several innovative papers on radiative transfer, and the two men cooperated in designing a wide-angle camera used by reconnaissance aircraft in World War II. Soon after the war, Jesse began to use the high-resolution spectrograph on the McDonald telescope to derive the abundances of elements in stars.

In 1948, Jesse moved to Caltech, where he founded a new department of astronomy and held the position of executive officer of astronomy until 1972. (See the article by Patrick McCray in PHYSICS TODAY, October 2003, page 55.) With his appointment to Caltech came access to the new 200-inch telescope on Mount Palomar, with its excellent spectrographs designed by its director, Ira S. Bowen. Telescope time was automatic in those days—about three nights a month available to each staff astronomer. That schedule enabled Jesse to assemble a large collection of high-resolution spectra of a wide variety of stars to be analyzed for chemical composition. He secured substantial support from the US Air Force Office of Scientific Research to hire postdocs (including this author) who analyzed his spectra by the curve-of-growth technique and the more sophisticated model atmosphere method, whereby the stellar spectrum could be predicted and compared with the observed spectrum.

Because of his close friendship with William A. Fowler of the Caltech physics department, much of Jesse's research and that of his postdocs concerned individual stars that showed unusual elemental abundances on their surfaces. In 1963, Jesse was one of five authors of a paper that called attention to the most metal-poor stars then known. In another paper, he and I analyzed the carbon stars of the Galactic Halo and showed that they were greatly enhanced in heavy elements produced by neutron captures within their own interiors. Convective mixing brought the resulting products to the stellar surface.

At the same time he was assembling his collection of high-resolution spectra, he carried out an independent program of spectroscopy of white dwarf stars. That research resulted in his fundamental paper, written with Olin J. Eggen and published in the *Astrophysical Journal* in 1965, on the spectra and colors of white dwarfs. In 1964, Jesse and Maarten Schmidt published in the *Astrophysical Journal* the basic paper on the redshifts of the recently discovered quasars. In that article, they showed that neither a gravitational redshift nor rapid recession of nearby objects could explain the data, hence the observed redshifts had to be due to the cosmological expansion of the universe.

In later years, Jesse continued to observe and interpret the spectra of white dwarfs. During much of his work on faint stars, he took advantage of the multichannel scanner developed by J. Beverly Oke for the five-meter telescope at Palomar Observatory. Use of the scanner enabled him to investigate the properties of very faint main-sequence stars, including the metal-poor subdwarfs of the halo population. Perhaps the most fascinating of the subdwarfs is the dwarf carbon star, G77-61, analyzed by Jesse and five others in 1986.

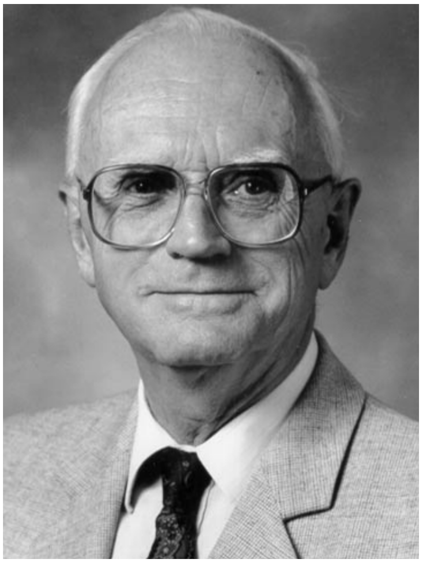
Jesse's last research paper, entitled "An Atlas of Optical Spectra of White Dwarf Stars," which he coauthored with six others, was published in the *Publications of the Astronomical Society of the Pacific* in 1993.

One of Jesse's finest characteristics as a thesis and general research adviser was his ability to imbue younger people with the self-confidence to become independent scientists. It is particularly important nowadays to recognize the value of such encouragement, especially when new postdocs join groups of 20 or 30 scientists on a single project, yet a postdoc's name likely will not be listed as first author unless it happens to begin with an *A*.

Jesse was a member of many government advisory committees, including one whose purpose was to evaluate whether nuclear weapons should be used to break the stalemate in the Korean War. The committee advised against such use, I am pleased to note, given that I was not far from the front lines at the time.

George Wallerstein
University of Washington
Seattle

John Peter Hobson



John Peter Hobson

On 17 February 2003, John Peter Hobson, a world-renowned expert in the fields of vacuum science and technology and surface science, died suddenly at his home in Ottawa, Ontario, Canada.

Peter was born in Ahmednagar, India, on 25 October 1924. His father, a native of Ireland, was a police officer in the Raj; his mother, a native of Canada, had taught at the University of Saskatchewan before marriage. In 1932, Peter's parents sent him to boarding school in Ireland, where he was joined by his brother in 1935. In May 1940, his mother went from India to Ireland and sailed with the two boys across the U-boat-infested Atlantic Ocean to the safety of Canada.

After attending high school in Vancouver, British Columbia, Peter joined the Canadian army in 1942, was trained as a radar technician, and was sent to the Pacific theater. When World War II ended, he entered the University of British Columbia and obtained an MASc in engineering physics in 1950.

Peter then went to the University of California, Berkeley, for his PhD. There, he measured the spin of rubidium-81, which has a half-life of only 4.7 hours. To transfer the sample quickly into the atomic beam apparatus, he had to design a vacuum loader—his first foray into vacuum technology.

In 1954, Peter joined the National Research Council of Canada in Ottawa, where he spent 32 years. In 1969, he was appointed head of the electron physics section, which was part of the radio and electrical engineering division. He became assistant director of the division in 1981 and retained that position four years later in the newly formed microstructural sciences division.

Despite his administrative duties, Peter maintained his personal research throughout his career at NRC. His initial research, in 1954, concerned the reflection of very slow (less than 40 eV) electrons from metal surfaces. Allowing sufficient time to make measurements required very low pressures to ensure that the metal surfaces remained clean at the molecular level. Ultrahigh vacuum was in its infancy: Daniel Alpert had announced the Bayard–Alpert gauge, which initiated reproducible UHV only four years earlier, and little UHV equipment was commercially available. The electron physics section had recently started a program to develop UHV techniques, and Peter's contribution was to investigate cryopumping methods using liquid helium as a coolant. That effort led him to study the operation of vacuum gauges at UHV pressures using liquid-helium-cooled cryopumps. Peter tested the original magnetron cold-cathode gauge, which had been developed in the section, down to 10^{-12} torr. A version of that gauge was used in the Explorer 17 satellite in 1963; an improved version was later sent to the Moon on the Apollo 12 mission in 1969 to measure the pressure of the lunar atmosphere and was also sent on Apollo missions 14 and 15 in January and June 1971, respectively.

The other major offshoot of Peter's work on helium cryopumping was a lengthy study of physical adsorption isotherms of helium, nitrogen, argon, krypton, and xenon over a very wide range of pressures from 10^3 to 10^{-11} torr. He was able to show that most of those data could be fitted to the Dubinin–Radushkevich isotherm. He also developed a new method of determining heterogeneous binding-energy distributions from physical adsorption isotherms. Peter's work on the physical adsorption of gases on heterogeneous surfaces at submonolayer coverage has had a profound impact on our understanding of physical adsorption with applications to cryopumping, particularly in accelerators and storage rings.

Peter continued his work on UHV technology for many years. In 1964, he created the lowest pressure ever measured, a record that still stands today, of about 10^{-14} torr in an aluminosilicate glass system pumped by a liquid-helium-cooled cryopump. He also performed many experiments to establish the physical and chemical processes limiting the lowest pressures obtainable in UHV systems. As a result of his studies on thermal transpiration, Peter invented the accommodation pump in the early 1970s.

The accommodation pump developed a pressure difference between two glass vacuum chambers at room temperature joined by a U-shaped glass tube immersed in a suitable coolant; the surface of one arm of the U-tube was roughened (leached) and the other arm was smooth (fire polished). The proposed mechanism is speculative, but involves non-cosine distribution of gas molecules scattered at the surfaces. In the late 1970s, he participated in the development of an apparatus for transferring a sample from one vacuum system to another while the sample was held at UHV pressures. He demonstrated use of the apparatus by transferring a sample from Ottawa to Vienna, Austria, while maintaining a pressure of less than 10^{-10} torr.