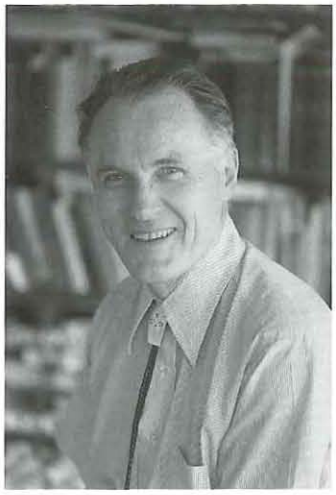
Obituaries



Robert B. Leighton
1919 – 1997

Robert B. Leighton, the William L. Valentine Professor of Physics, Emeritus, passed away on the morning of March 9, 1997.

Bob spent his entire scientific career at Caltech, and he established a dominating presence in physics and astronomy research and teaching here. His work over the years spanned solid state physics, cosmic ray physics, the beginnings of modern particle physics, solar physics, the planets, infrared astronomy, and millimeter- and submillimeter-wave astronomy. In the latter four fields, his pioneering work opened up entirely new scientific areas of research that subsequently developed into vigorous scientific communities. In addition, he was a renowned teacher, having edited *The Feynman Lectures in Physics* into their printed form and authored a highly influential text, *Principles of Modern Physics*. For his contemporaries, he set a high standard of teaching quality. In addition, he coauthored, with Robbie Vogt, a set of problems to accompany the Feynman lectures.

In 1948, Leighton's first scientific publication concerned the specific heat of face-centered cubic crystals, but he had already been drawn into Caltech's strong cosmic ray group under Carl Anderson's leadership. He played a key role in 1949 in showing that the mu-meson decay products are two neutrinos and an electron, and he made the first measurement of the energy spectrum of the decay electron (at the time, low statistics experiments suggested that only one neutrino was involved). In 1950, he made the first observation of strange particle decays after the initial discovery of two cases in England in 1947. Over the next seven years, he elucidated many of the properties—for example, mass, lifetime, decay-modes, and energies—of several of the new strange particles, in particular, the lambda, the xi, and what were then called the theta particles (K-mesons).

About 1956, Leighton became interested in the physics of the outer layers of the sun. With characteristic imagination and insight, he devised Doppler-shift and Zeeman-effect solar cameras. They were applied with striking success to the investigation of magnetic and velocity fields on the sun. With the Zeeman camera, Leighton and his students mapped complicated patterns of the sun's magnetic field with excellent resolution. Even more striking were his discoveries of a remarkable five-minute oscillation in local surface velocities and of a "super-granulation pattern" of horizontal convection currents in large cells of moving material. These solar oscillations have subsequently been recognized as internally trapped acoustic waves, which opened up the whole new field of solar seismology, subsequently pursued by Ken Libbrecht.

In the early 1960s, Leighton developed and fabricated a novel, inexpensive infrared telescope. He and Gerry Neugebauer used it to produce the first survey of the sky at 2.2 microns. This survey revealed an unexpectedly large number of relatively cool objects. Some of these have been found to be new stars still surrounded by their dusty prestellar shells, while others are supergiant stars in the last stages of their evolution, embedded in expanding dusty shells of matter ejected by the stars themselves.

During the middle 1960s Leighton was the team leader at JPL for the Imaging Science Investigations on the Mariner 4, 6, and 7 missions to Mars. As team leader and an experienced experimental physicist, Leighton played a

key role in forming and guiding the development of JPL's first digital television system for use in deep space. He also contributed to the first efforts at image processing and enhancement techniques made possible by the digital form of the imaging data.

In the 1970s, Leighton's interest shifted to the development of large, inexpensive dish antenna which could be used to pursue millimeter-wave interferometry and submillimeter-wave astronomy. Once again, his remarkable experimental abilities opened a new field of science at Caltech which continues to be vigorously pursued at the Owens Valley Radio Observatory (OVRO) and the Caltech Submillimeter Observatory (CSO) on Mauna Kea using the "Leighton Dishes."

Born in Detroit, September 10, 1919, Dr. Leighton received his BS in 1941, his MS in 1944, and his PhD in 1947, all from Caltech. He continued here as a research fellow (1947-1949), assistant professor (1949-1953), associate professor (1953-1959), professor (1959-1984), the Valentine Professor of Physics (1984-1985), and Valentine Professor, Emeritus (1985-1997). Bob served as chair of the Division of Physics, Mathematics and Astronomy from 1970 to 1975.

All of us who knew and deeply admired Bob Leighton miss him greatly.

Charles Peck
Professor of Physics
Chair, Division of Physics, Mathematics and Astronomy

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He would always try something new, a different approach to something old, and it paid off in a large number of fundamental discoveries made possible only by his curiosity and skill.

Bob was my personal friend and I worked so closely with him as his student and then as his colleague that it is hard to limit myself to just a few remembrances.

When I first met Bob, he was in the Bridge machine shop working at a lathe. The impression of that first meeting—that here was a true "hands-on" experimentalist—lasted as long as I worked with Bob. Only later did I learn that to do a complicated triple numerical integration for his thesis, Bob had machined the complicated shape out of metal and weighed it. Not only was he a great experimentalist, he was clever.

As I worked with him, I came to appreciate his truly awesome intellectual capabilities. Although an experimentalist, Bob could keep up with essentially any theoretical discussion that had to do with how the world worked; he loved physics. As a graduate student under Bob, I did all the problems in his book. I don't think he was especially impressed; he expected you to do all the problems. That was how he felt you learned.

Bob had about the most inquisitive mind I ever came across. He had to know how everything worked. One rule was that he was always willing to try something new and different. He felt he should never compete with someone, but always do something unique, something that only he could do. It was this principle and his imagination that led him into the many and various things he did so well. He would always try something new, a different approach to something old, and it paid off in a large number of fundamental discoveries made possible only by his curiosity and skill.

The highlight of my association with Bob was the Two Micron Survey of the sky. Bob had the idea of making near-optical-quality mirrors by spinning liquid epoxy, then a new material, and letting it harden while spinning in its natural form, a parabola. He used an air bearing, like one he and Vic Neher had used to demonstrate frictionless motion to the freshmen students, to support the epoxy while it was hardening. We built the telescope in the Bridge machine shops. It was truly Bob's telescope; he had built an "amateur" telescope at home, and now he used every trick he had learned and more to design a 62-inch telescope, a good size for its day. Everything was done on the cheap, emphasizing Bob's cleverness. We needed to "chop" to rapidly sample alternating pieces of the sky, so Bob made the whole telescope shake back and forth at 20 cycles per second. Domes are expensive, so Bob led a group of us—including Jerry Nelson, an undergrad who would later spearhead building the Keck 10-meter telescopes—to Mt. Wilson, and we built the roll-off building to house the tele-scope. Bob had, after all, built his own home all by himself. The astronomy pundits said that at most the survey would detect tens of sources; we ended up detect-

ing thousands. The very first night we turned the telescope to the sky we detected the reddest, most extreme source that we found in the entire three years of surveying. It was typical of Bob's good luck, good luck he worked hard to have. I might add that Bob's 62-inch telescope now is in Washington, DC, in the Air and Space Museum of the Smithsonian Institution.

Bob was a great friend with a fine sense of humor and wonderful to know socially as well as in the lab. In those days the Athenaeum required coats and ties for lunch. Although Bob normally wore a coat and tie every day himself, he was aware of my discomfort and took pity. Thus one hot day Bob took his coat off while eating lunch at the Athenaeum. The horrified maitre d' said, "Dr. Leighton, the rule is that coats are required." Bob calmly replied that he understood the rules. Clearly the maitre d' had done his duty, but Bob stood his ground and from that day on, coats were no longer required for lunch.

As I said, Bob was wonderful to work with. He provided inspiration for people at Caltech ranging from undergrads to senior faculty. Mainly he gave support and encouragement to a large number of young people. He was unstinting in helping people get started. A whole crop of people at Caltech got their beginning with Bob or carried out projects that Bob thought of or thought were good to do. And he was more than generous in giving credit. When the Two Micron Survey was published, Bob insisted that I, not he, be the first author, claiming that I needed the exposure more than he did. For this and many other kindnesses, I'll always be thankful to Bob and hope that we can in some way follow in his footsteps.

Gerry Neugebauer, PhD '60
Robert A. Millikan Professor of Physics

Verner Schomaker
1914 – 1997

Verner Schomaker, possessor of one of the most critical and wide-ranging scientific intellects of our time, died in Pasadena, California, on March 30, 1997, of pancreatic cancer. What follows is a very personal account. Many of those who worked with or were closely exposed to Verner might have written something similar; I am confident that the general flavor would be the same.

Every scientific question seemed to interest Verner, and anyone with a knotty problem was welcome at his always-open door. And his time was always yours—until he, at least, understood in some depth what you were asking, and preferably you did too. The answer did not, of course, always come in one session—even though the sessions could last for many hours, past meal times and past other appointments that you forgot about because you were so engrossed. His memory was prodigious, and when he encountered a problem he 'worried it,' like a dog with a bone. He might not have all the insight he wanted when the question was first raised or even during the next few days or weeks—but he wouldn't forget. You might encounter him some years later, and he'd say, "I've been thinking about what you said, and . . ."

He was at once friendly, open, uncommonly generous, and extremely bright. He was, to those who were privileged to work with him or otherwise benefit from his insights, simply without peer as a one-on-one teacher. In the '40s and '50s, many who worked with him felt complimented when he would say, "How can you be so goddamned stupid?" since we realized that he *expected* us to understand and that, frustrated though he might be with our slowness, he would not give up until we understood, or left. In his later years, he learned patience and mellowed somewhat, and those who couldn't follow an abstruse line of reasoning he was explaining might be asked, "What do I have to do, say it *louder*?" But *never*, and I do mean ***never***, was there any animosity involved in what might seem to some to be harsh remarks. Nor did Verner's own ego ever intrude. He was selfless, far more so than almost anyone imaginable with his level of intellect and accomplishment. He was interested in getting things *right*, not in who got the credit, and was never afraid to admit his errors and his own limitations, although he overestimated them (as he, generously, did the abilities of some of his collaborators).

He is best known for his contributions in electron and X-ray diffraction. He thought that his most important contribution had been in the early days of electron diffraction, for development of techniques for the visual interpretation of the scattering of electrons by gas molecules. None of the structures reported from his productive group had later to be revised, when sector methods gave greater resolution and precision. But he published in many other fields as well—one of his final papers (with Jürg Waser) was on the "Global Thermodynamics

of Systems That Include Stressed Solids," and he was saddened that he could not interest any colleague in studying it intently enough to discuss it with him meaningfully. At least one of his papers became a "citation classic" in the Science Citation Index. His total publication list, however, probably didn't reach 200 papers, because he was a perfectionist when writing a paper, and because he was so readily distracted by the intriguing problems presented by those who sought him out. His generous spirit, his penetrating intellect, his breadth of interests and curiosity, and his selflessness led almost everyone within his orbit to use him as a consultant. There is little doubt that if there were a "Science Advisor Acknowledgment Index," he would have ranked at or very near the top. It has been estimated that during the '40s and '50s, at least one third, and perhaps as many as one half, of the papers published by the Gates and Crellin Laboratories (the Caltech Division of Chemistry) concluded with a phrase such as, "We are grateful to Professor Verner Schomaker for helpful discussions," or "The valuable insights provided by our colleague Verner Schomaker helped to make this work possible." And these papers covered the gamut of work in the division, not just in diffraction, but in quantum mechanics, immunochemistry, NMR, spectroscopy, thermodynamics, and inorganic and organic chemistry. In those years, the reference "V. Schomaker, unpublished" was extremely common—in others' papers especially.

A native of Nebraska, where he grew up on a farm, he earned a BS from that state's university in 1934 and an MS in 1935. He then moved to Pasadena, where Pauling quickly recognized his uncommon qualities. After receiving a PhD in 1938, he went up the academic ladder in chemistry at Caltech (taking time out for wartime research from 1942 to 1945). In 1958 he left academic work to join the Union Carbide Research Institute (just north of New York City), where he spent seven years—but when it became apparent that the initial promise of something modeled on the Bell Labs or what was then the Shell Development Laboratory was never going to materialize, he joined the faculty of the Department of Chemistry at the University of Washington in Seattle. He became professor emeritus in 1984. After his retirement, he was also a faculty associate at Caltech, dividing his time about equally between Pasadena and Seattle.

His family has requested that donations in his memory be made to the Verner Schomaker Memorial Fund, California Institute of Technology, Office of Donor Relations, Mail Code 105-40, Pasadena, California 91125. The fund will be used to support student research.

Kenneth Trueblood, PhD '47
Professor of Chemistry, UCLA

He might not have all the insight he wanted when the question was first raised or even during the next few days or weeks—but he wouldn't forget. You might encounter him some years later, and he'd say, "I've been thinking about what you said, and . . ."

I always admired Verner's great brillance and his deep humanity. His analytical and quick mind always went to the nub of a problem that he faced or was presented with, and he often quickly solved these problems. His mathematical ability and his structural insights were very great and his colleagues as well as industry frequently sought his advice, including the great Linus Pauling. He liberally and freely gave of himself. His mechanical abilities were equally great, and premier among the many apparatus he designed, there was a fine electron diffraction machine with a rotating sector. On a more personal note, I well remember a camping trip on which the car broke down way out in the tules. His methodical approach quickly located the problem: a part in the distributor had broken down. Whittling a replacement out of a twig and carefully cutting a gasket from strong paper readily fixed the problem.

Verner was highly critical of ideas presented to him and could be scathing and scornful. His deep-seated honesty would not allow him to pass over any shallow or pretentious assertion lightly, and his criticism could be blunt. Yet he was also extremely helpful to everybody, especially to an underdog. Thus he took under his wing a young fellow recently from Switzerland who had come to study under Linus Pauling and was quite overwhelmed by the brillance of the other students and the quality of the research at the Institute.

They say "they don't make them like that any more," but this is very subjective. It is mainly for us oldsters for whom the world has become more lonely. I miss you, Verner, and the many great and heated discussions we had.

Jürg Waser, PhD '44
Professor of Chemistry (1958–75)

Edward E. Zukoski
1927 – 1997

Edward E. Zukoski (MS '51, PhD '54), an authority on the science and technology of combustion, a highly respected member of the Caltech faculty for 40 years, and a bouyant friend to all who knew him, died on May 26, 1997, of complications attending a heart attack several years ago. Ed possessed an exuberance for life and for his work that was so rich it warmed us and brightened our days. When he was in good voice his hearty laugh echoed throughout all of Guggenheim. And with the same emotional energy, he fumed against stupidity and arrogance in science and in public life.

Ed served as my alterconscience; new work, curriculum innovations, novel concepts—rational and irrational—were usually first unloaded on Ed.

Ed was born June 29, 1927, in Birmingham, Alabama, into a professionally and socially prominent family that was committed to public service and at times espoused liberal causes that might, considering the place and time, seem unusual to us and certainly to Birmingham society. Continuing in the family tradition, Ed attended Harvard College and received the bachelor's degree of engineering science in 1950. That same year he was awarded one of the new Guggenheim Fellowships in Jet Propulsion to attend Caltech, studying aeronautics with emphasis on jet propulsion in the center inaugurated by Professor Tsien Hsue-shen the previous year.

It was Ed's good fortune that experimental combustion facilities at the Jet Propulsion Laboratory were available for his use in pursuing his doctoral research, which attacked an urgent current problem of combustion stability in ramjet engines and gas turbine afterburners. In addition to resolving confusion that had persisted in the field for years, Ed's work laid the foundations of the flame holding mechanism and established him as an objective and meticulous experimentalist. Ed's experimental research, together with the analysis carried out by his fellow research student, Tom Adamson, opened a large field of combustion issues in which the fluid mechanical and chemical aspects of the problem could, to a certain extent, be separated.

Ed continued his experimental combustion research at JPL for three years after completing his doctorate and joined the Caltech faculty as assistant professor of jet propulsion in 1957. During his long career at Caltech, Ed and his students made major innovative contributions in other fields: magnetogasdynamics, aeroacoustics, problems of propellant control under microgravity conditions and, most recently, hydrogen/air mixing in supersonic combustion ramjet propulsion systems. In each of these activities Ed left his characteristic mark of objective and thorough experimental research, eschewing the experimentalist's natural diversion from the physical problem toward elegant instrumentation.

In the summer of 1961, Ed participated in a fire research study directed by Howard Emmons and sponsored by the National Research Council. The problems of unwanted forest fires and building fires appealed to him both as a technological challenge and as an important issue of public service. Over the years Ed became a national leader in fire research and, together with his students and his colleague Toshi Kubota, developed a comprehensive description of convective fire plumes that has become the technological standard. A symposium on the fluid mechanics of fire plumes, organized by his former student Baki Cetegen, was held in his honor in 1996 at the meeting of the United States/Japan National Resources Panel on Fire Research and Safety in Gaithersburg, Maryland.

There are other facets in Ed's life that, I think, highlight some of the essential attributes that make Caltech the unique institution we know. Ed was my third doctoral student; over a period of 45 years we shared a close collegial relationship in our research, our teaching, and the supervision of our research students. Ed served as my alterconscience; new work, curriculum innovations, novel concepts—rational and irrational—were usually first unloaded on Ed.

During his doctoral studies until sometime before his marriage to Joan Breck-

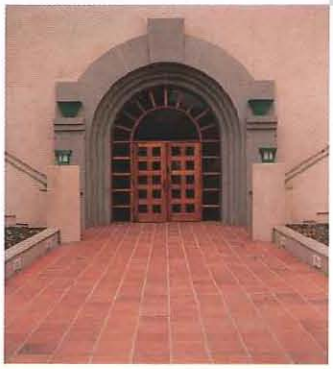
enridge, he was a fixture in the Marble household. He accompanied us on camping trips with our children, worked with us on remodelling our house, and even filled in as baby-sitter. He was a strong swimmer and an avid skin diver. It was not unusual on a late weekend afternoon for Ed to show up at our front door, still damp from his activities, with a sack of abalone (those were the days!) and an expression strongly suggesting that it would be great with him if my wife would prepare some for dinner. His suggestion was never refused. Our children considered him family, frequently more tolerant than their parents. When, on one of our camping trips in Arizona, Ed engineered the capture of a weary tarantula, he became their hero.

In many ways Edward Zukoski contributed, sometimes energetically but often quietly and unobtrusively, to the quality of our lives in both the Guggenheim and the Thomas Laboratories. He will be sorely missed.

Frank E. Marble (Eng '47,PhD '48), Richard L. and Dorothy M. Hayman Professor of Mechanical Engineering and Professor of Jet Propulsion, Emeritus

Memorial donations may be sent to Planned Parenthood of Pasadena, 1045 N. Lake Ave., Pasadena, CA 91107; or to the Wilderness Society, c/o Pamela Eaton, 7475 Daykin St., Suite 410, Denver, CO 80221.

Honors and Awards



Caltech's Moore Laboratory (above) and Avery House were jointly selected to receive the Crown City Award for architectural and/or landscape excellence from the Pasadena Beautiful Foundation.

Michael Alvarez, associate professor of political science, has been awarded a 1997 Haynes Foundation Faculty Fellowship for his proposal, "Who Governs Southern California: Will the Rise of Latino Political Power Continue?"

William Deverell, associate professor of history, has been elected to the board of the California Council for the Humanities. The Council both administers a competitive grants program and conducts projects of its own, including several planned for the California Sesquicentennial, beginning in 1998.

Kenneth Farley, associate professor of geochemistry, has been given a five-year fellowship by the David and Lucile Packard Foundation.

Donald Helmberger, professor of geophysics, has been selected by the American Geophysical Union to receive the 1997 Inge Lehmann Medal, which is awarded for outstanding contributions to the understanding of the structure, composition, and dynamics of the Earth's mantle and core.

Sossina Haile, assistant professor of materials science, has been chosen by the Minerals, Metals, and Materials Society to receive the 1997 Robert Lansing Hardy Medal, which recognizes exceptional promise in a young person in the field of metallurgy. Haile studies solid-state ionics, which conduct electricity through ions rather than electrons and are important in fuel cells, which may one day provide a clean, alternative energy source.

Wilfred Iwan (BS '57, MS '58, PhD '61), professor of applied mechanics and director of the Earthquake Engineering Research Laboratory, has been awarded the 1997 Nathan M. Newmark Medal from the American Society of Civil Engineers for his contributions to the dynamic analysis of buildings and other structures.

Jonathan Katz, assistant professor of political science, has been selected for the 1997 *Congressional Quarterly* Press Award for the best paper in the field of legislative politics presented at the 1996 American Political Science Association meeting. The paper, which he cowrote with Gary Cox (BS '78, PhD '83), was entitled "Baker v. Carr and Incumbency in Postwar U.S. House Elections."

Wolfgang Knauss (BS '58, MS '59, PhD '63), professor of aeronautics and applied mechanics, was elected an Honorary Fellow by the International Congress on