The annual Gaseous Electronics Conference (first initiated by his former student, Leon H. Fisher) became his adopted forum and happy meeting ground. It is likely that his attendance record exceeds that of any other participant, with probably only one absence in 30 years.

Leonard Loeb will be deeply and sincerely missed, throughout the world. He played a role in the lives of many people in addition to students and professional colleagues.

ROBERT N. VARNEY
Palo Alto, California

Arthur L. Hughes

Arthur Llewellyn Hughes, Wayman Crow Professor Emeritus of Washington University, St. Louis, died on 25 June in his 95th year. His career extended from work under Charles Barkla in Liverpool University in 1903, through Cambridge University under J. J. Thomson to his investigation of ultrasonic triggering of spark chambers in the 1960's. He was chairman of the physics department at Washington University from 1923 until 1953.

Hughes was born in Liverpool in 1883 and grew up in a small Welsh village. His early years were typical of that impoverished part: His father died when he was 14, and to support his mother and sister he applied for a job as a telegraph messenger, but failed by one inch to meet the minimum height requirement. At Liverpool University, he started to train as a teacher but was converted to his enduring interest in physics when Barkla needed an inexperienced assistant to take unbiased measurements of his gold-leaf electroscope. In 1908, he won a prestigious "1851 Exhibition Scholarship," which took him to Cambridge. There, as Thomson's last student, he was assigned the task of investigating the kinetic energies of photoelectrons as a function of the wavelength of the incident light. His major paper (Phil. Trans. Roy. Soc. Lond. **212**, 205 (1913)) was the first to demonstrate the linearity of the relation, although it is interesting to note that that paper contains no reference to Einstein and, in later years, Hughes could not recollect either Thomson or himself being aware of Einstein's theory!

Following the award of his DSc in 1912, Hughes held faculty appointments first at the newly-established Rice Institute in Houston, and then at Queens College, Ontario, with an interval in England during World War II to work on the sonic detection of submarines. In 1923 he was appointed to the chairmanship of the department in St. Louis, succeeding Arthur Compton who was leaving for Chicago.

During 30 years as chairman, Hughes guided the department through the difficult years of the Depression and World

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War II. After the war, with Compton now the University Chancellor, Hughes could plan an enlarged department, and his first three appointments were Eugene Feenberg, Henry Primakoff and Robert Sard. Even after his retirement and until his late 80's, Hughes continued with his research and always maintained his lively interest in current physics. Throughout his many years here, Hughes was particularly concerned with encouraging his students and the younger faculty. Typically, he engaged Lee DuBridge as an assistant professor in 1928 and invited him to collaborate on what was to become the standard reference work: *Photoelectric Phenomena* (McGraw Hill, 1932). DuBridge reminisced on the occasion of Hughes's 80th birthday that he could think of "no more wonderful place to have begun my career in physics . . . the enthusiasm which you yourself showed in your work and in the work of your colleagues was conveyed to all of us."

Hughes set uncompromisingly high standards for himself and, while he judged others' work by those same standards, he was humane and considerate in his comments. As a teacher he was greatly admired and warmly regarded by his students; as a senior colleague he held a unique place in our affections. Each of us will remember him in our own way, with pleasure.

MICHAEL FRIEDLANDER
Washington University

Judith Bregman

Judith Bregman, professor of physics at the Polytechnic Institute of New York, died of cancer on 2 October, at the age of 57. Her BA from Bryn Mawr in 1942 and her PhD from Cornell University in 1950 were both in physical chemistry, and she was an instructor in chemistry at Barnard College during 1946–48. As a research associate at MIT and at Harvard Medical School she worked in x-ray crystallography, electron diffraction and light scattering, mainly as applied to molecular structure of organic compounds. In 1955 she became a research associate in physics at the Polytechnic Institute of Brooklyn and joined the physics faculty there in 1957. In 1958 she went on leave to the Weizmann Institute in Israel as Weizman Memorial Fellow, and remained until 1962 as a Senior Scientist, acting as head of the department of x-ray crystallography during 1959–61. Since her return she had remained at the Polytechnic Institute.

Bregman became interested in the preparation of instructional films, served on the Board of the American Science Film Association and was a member of the Higher Education Section Committee of the International Scientific Film Association. Her film, *Symmetry*, prepared in 1966 with Alan Holden, Richard Davisson and Philip Stapp, won both national and international honors, and is noteworthy as a combination of art and science. She has been instrumental in the making of other films, notably *Aspects of Symmetry* and computer representations of quantum-mechanical wave-packet behavior.

Judy Bregman has long participated in the struggle for the preservation and extension of human rights. Beginning with the fight for civilian control of atomic energy in the late 1940's she was active in the Federation of American Scientists, serving on the FAS council for several years. During the 1960's she was student draft counsellor at Poly, an activity much appreciated by students throughout the Vietnam War. She was an effective member of the Polytechnic Affirmative Action Committee, and took part in the Association for Women in Science. Even more recently she became a member of the Equality Committee of the American Civil Liberties Union.

Bregman's scientific contacts were widespread: she was a member of the American Physical Society, the American Crystallographic Association, the American Chemical Society, and the American Association of Physics Teachers (serving on the AAPT Instructional Media Com-

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obituaries

mittee), not to mention Sigma Xi and the New York Academy of Sciences. Judy travelled widely, and in addition to her other gifts had a great talent for friendship. Her enthusiasm and zest for life were contagious. Colleagues and friends in many parts of the world will be deeply grieved by her untimely death.

MELBA PHILLIPS
New York, N.Y.

Bruce V. Waddell

Bruce V. Waddell died after a long illness in Oak Ridge, Tennessee, 14 September at the age of 31. His death came just when his accomplishments had gained him an international reputation in the field of plasma theory.

Waddell was born and raised in the small community of St. Charles, Virginia. As an undergraduate physics major at the University of Kentucky, he was already doing original work in atomic physics with George S. Hurst, earning him the school's Oswald Award. His graduate work in plasma physics at MIT under Bruno Coppi was on the topic "Effects of Toroidal Plasma Modes on Transport Coefficients." In recognition of his academic achievements he was awarded many academic honors, including the prestigious National Science Foundation and Woodrow Wilson fellowships. At this point it was already apparent that he was a brilliant scholar who would be one of the future leaders in the field.

After receiving his PhD in physics, he realized an early childhood ambition by undertaking post-doctoral work at the Institute for Advanced Study. There he became interested in the topic that was to occupy him for the rest of his life—the nonlinear behavior of magnetohydrodynamic and resistive instabilities. As in many branches of physics, the linear theory of waves or instabilities is easy to

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