faculty of the University of Massachusetts, Amherst, where he remained until 1981. From 1977 to 1981 he was the associate director of the Five College Radio Astronomy Observatory. Since 1980 he has been a member of the physics faculty at Princeton.

In 1953 Pople and, independently, Rudolph Pariser, then of Du Pont, and Robert Parr, then of the Carnegie Institute of Technology, developed a semiempirical model of molecular orbitals that accounted only for the electrons in π orbitals. The Pariser–Parr–Pople model applied only to planar conjugated molecules, because their delocalized electrons are easier to handle than the electrons of other types, Pople told us.

In the 1960s Pople and various collaborators set forth more sophisticated molecular orbital models that included the σ-orbital electron interactions: the complete neglect of differential overlap, or CNDO, and intermediate neglect of differential overlap, or INDO, models. These models generalized the PPP model to three-dimensional molecules. As such they allowed better calculations of molecular properties such as structures; bond lengths and angles; harmonic frequencies and force constants; and the energies of excited electron states.

By the late 1960s Pople began to work on *ab initio* methods that determined molecular orbitals directly from the laws of quantum mechanics and the fundamental physical constants. Such calculations do not require empirical parameters, which were chosen somewhat arbitrarily when used in the earlier semiempirical methods. As a result, the *ab initio* methods have greater power to predict molecular properties, as well as a firmer epistemological basis.

Pople was among the early developers of minimal basis sets—that is, linear combinations of ground-state atomic orbitals—to get a single determinant for a molecule's Hartree–Fock wavefunction. The basis sets enabled him to calculate the wavefunction for polyatomic molecules. Pople then developed larger basis sets that included the d and f orbitals. Pople and coworkers were instrumental in the systematic development of many-body perturbation methods for incorporating specific electron interactions, which Hartree–Fock theory neglects. Such methods allow one to predict molecular wavefunctions with even greater accuracy.

Pople's use of computers since 1970 has enabled him and many coworkers to speed up the calculation of molecular energies and properties. He and his team wrote a computer program called Gaussian to perform the required mathematical operations. The program is widely used, particularly by quantum and organic chemists. It is updated and revised every few years; its current version is Gaussian 92.

Pople received his BA (1946), MA (1950) and PhD (1951) in mathematics from Cambridge University. After that he was first a research fellow and subsequently a lecturer at Trinity College, Cambridge, until 1958. From then until 1964 he was superintendent of the basic physics division of the National Physics Laboratory in Teddington, England. He was Carnegie Professor of Chemical Physics at Carnegie Mellon from 1964 to 1974, when he was named to his present chair. Since 1986 he has also been a chemistry professor at Northwestern University.

APS PRIZES AND AWARDS ARE HIGHLIGHTS OF APRIL MEETING

One of the highlights of the American Physical Society meeting held in Washington, DC, in April was the presentation of a number of prizes and awards in recognition of achievements in physics.

The 1992 Tom W. Bonner Prize, given for contributions to nuclear physics, was presented to Henry G. Blosser of Michigan State University and Robert E. Pollock of Indiana University. The two were cited for "their pioneering development of innovative accelerator configurations, which have allowed new levels of precision and flexibility for nuclear physics research."

As director of Michigan State's cyclotron laboratory from 1958 to 1989, Blosser supervised the construction of the first precision cyclotron, and he later developed techniques for combining its particle beams with magnetic spectrographs to permit unprecedented time and energy resolution in studying the products of nuclear reactions. He led the design and construction of the first superconducting cyclotron. Blosser received a PhD in physics from the University of Virginia in 1954. After working at Oak Ridge National Laboratory for four years, he joined the Michigan State faculty in 1958. He is currently the University Distinguished Professor of Physics there.

Pollock was director of Indiana's cyclotron facility from 1972 to 1979, during which time he oversaw construction of the cyclotron and developed pion and light-particle spectrometers and other measurement devices. The cooling ring he designed has been used to study the production of mesons near threshold. Pollock earned a PhD in physics from Princeton in 1963 and was a member of the physics faculty there from 1964 to 1969. He went to Indiana in 1970 and is now the Distinguished Professor of Physics there.

The Dannie Heineman Prize for Mathematical Physics, awarded by APS and the American Institute of Physics, was given to Stanley Mandelstam of the University of California, Berkeley. He was cited for "his fundamental contributions to elementary-particle physics, including the Mandelstam representation—which displays the analyticity properties of scattering amplitudes—the formulation of the relativistic string as a unitary theory of interacting particles and his influential work on gauge theories." His representation of the analytic properties of scattering amplitudes in the form of double dispersion relations is basic to the modern understanding of relativistic particle scattering, and he was among the first to apply path-integral quantization methods to string theory.

Mandelstam earned a PhD in mathematical physics from the University of Birmingham (England) in 1956. He was a professor of mathematical physics there from 1960 to 1963 and then became a professor of physics at Berkeley.

Claude N. Cohen-Tannoudji of the Collège de France and Alan H. Guth of MIT were this year's recipients of the Lilienfeld Prize. Cohen-Tannoudji was cited for "his unique contributions to the understanding of atomic systems in electromagnetic fields and for his expository skills. He has made singular contributions to the theory of 'dressed atoms,' optical pumping and cooling, and resonance fluorescence and has experimentally verified some of his predictions." Most recently Cohen-Tannoudji has demonstrated new, more efficient optical cooling processes that contradict previous predictions of a theoretical lower limit to the temperature achievable by radiative cooling.

Cohen-Tannoudji earned a DSc in atomic and molecular physics from

the University of Paris in 1962. From 1964 to 1973 he was a professor there, and he then moved to the Collège de France, where he is a professor of atomic and molecular physics.

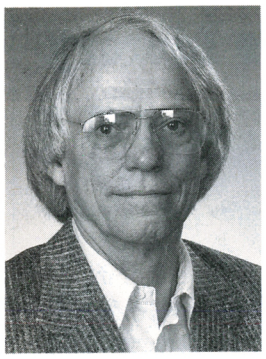
Guth was cited for "his concept of the inflationary universe, which has revolutionized the way in which cosmologists think about the earliest moments of the universe. The clarity of his presentations, both written and spoken, have made his important ideas accessible to expert and layman alike." Guth's ideas about the early universe, now widely accepted, have given rise to a new field of research that applies elementary-particle physics to cosmology.

Guth received a PhD in physics from MIT in 1972. After working as an instructor at Princeton and as a research associate at Columbia, Cornell and the Stanford Linear Accelerator Center, he joined the MIT faculty in 1980. He is currently the Victor F. Weisskopf Professor of Physics there.

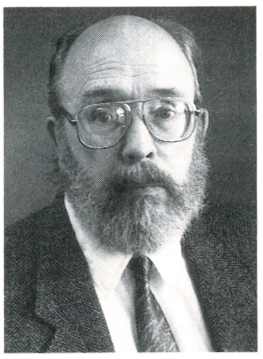
The 1992 Panofsky Prize for achievements in experimental particle physics was given to Raymond Davis Jr of the University of Pennsylvania and Frederick Reines of the University of California, Irvine. The two were cited for "development of neutrino detection techniques and their applications to fundamental problems in particle physics and astrophysics."

Davis's design of the first detector to measure solar neutrinos made use of a large tank of cleaning fluid placed in the Homestake gold mine to shield it from the interference of cosmic rays. With it he discovered a deficit in the number of neutrinos predicted by theoretical models of solar fusion. Davis earned a PhD in physical chemistry from Yale in 1942 and then served in the US Air Force for four years. After working briefly at Monsanto Chemical Company, he joined the staff at Brookhaven National Laboratory in 1948. Since 1985 he has been a professor in the astronomy department at Penn.

Reines and Clyde Cowan Jr discovered the neutrino in 1956. More than 30 years later a research team now known as the neutrino group and led by Reines measured various neutrino properties and used the Irvine–Michigan–Brookhaven detector to record neutrinos from supernova 1987A. The IMB detector also tested p-decay theory and found it wanting. Reines earned a PhD in theoretical physics from New York University in 1944 and then worked at Los Alamos Scientific Laboratory. From 1959 to 1966 he was head of the physics depart-



Henry G. Blosser



Robert E. Pollock

Stanley Mandelstam

Claude Cohen-Tannoudji

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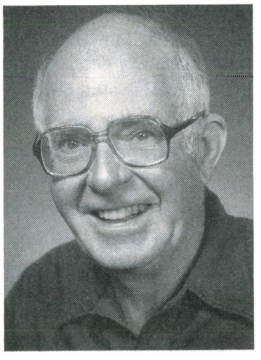
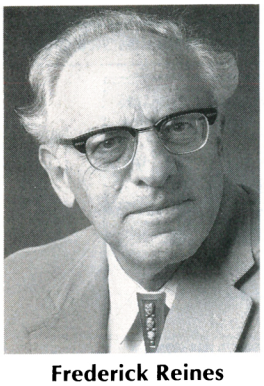
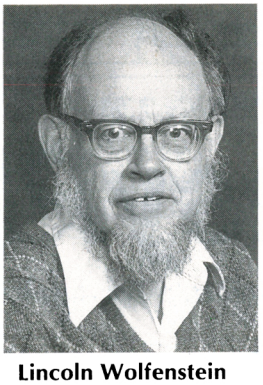


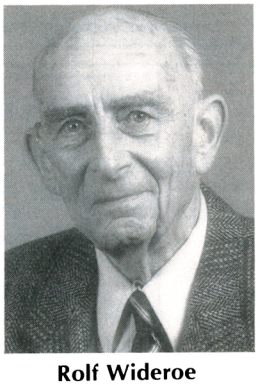
Raymond Davis Jr



Frederick Reines



Lincoln Wolfenstein



Rolf Wideroe

ment at Case Institute of Technology. He then moved to Irvine, where he was the first dean of physical sciences and is now a professor of physics.

Lincoln Wolfenstein of Carnegie Mellon University was given the Sakurai Prize, which recognizes achievements in particle theory. He was cited for "his many contributions to the theory of weak interactions, particularly *CP* violation and the properties of neutrinos." Wolfenstein is perhaps best known for developing the superweak theory of CP violation in 1964. He has also investigated the interactions and properties of neutrinos, including neutrino oscillations in matter.

Wolfenstein earned a PhD in physics from the University of Chicago in 1949 and joined the Carnegie Mellon faculty that same year. He is currently the University Professor of Physics there.

The 1992 Wilson Prize was given to Rolf Wideroe for "his many contributions to accelerator physics and technology beginning in the 1920s, including the development of betatrons, radiofrequency acceleration in linacs and later in synchrotrons, injection and extraction from circular accelerators and the colliding-beam concept." Wideroe invented the betatron in 1922 and developed the strong-focusing storage rings and colliders for Europe's first betatron, built in Hamburg in 1944–45. In 1965 he developed the two-component theory of radiation, which is now regarded as the best description of radiation-caused cell effects.

Wideroe earned a doctorate in engineering from the Technical University at Aachen in 1927. Prior to the war he worked in industry in Germany and Norway. From 1946 to 1975 he worked at Brown Boveri & Cie in Baden, Switzerland, where he developed and built betatrons and synchrotrons for nondestructive testing, physical research and radiotherapy.

Two students received Apker Awards for their research achievements as undergraduates. Dean Lee, who recently graduated from Harvard University, was cited for his research project "A Single Model of Two-Body Decays of Charmed Mesons into Pseudoscalar Mesons Using the $1/N$ Expansion," which he completed in his junior year. Lee developed his model to account for the lack of symmetry observed in SU(3) breaking and was able to make predictions about a number of decay processes that have yet to be measured. Lee now plans to do graduate work in particle physics at Harvard.

The other Apker Award was given to Stephen Quake, who graduated from Stanford in 1991, for his contributions to a research project studying the expression and repair of DNA using "optical tweezers." Working independently, Quake wrote a computer program to extract and analyze data for the project. Quake is currently at Oxford University on a Marshall Scholarship.

The 1992 Award for Outstanding Doctoral Thesis Research in Beam Physics, given by the APS division of physics of beams, went to David H. Whittum, a postdoc at the National Laboratory for High Energy Physics (KEK) in Japan. Whittum was cited for "his conceptual invention and theoretical investigation of the ion channel laser." Whittum developed the theory of an electromagnetic instability of an ion-focused relativistic electron beam, as well as a laser exploiting this instability.

Whittum earned a PhD in physics from the University of California, Berkeley, in 1990. He is now working at KEK on an ion-focused free-electron laser experiment.

James E. Koster, a postdoctoral fellow at Los Alamos National Laboratory, was presented with this year's Dissertation Award in Nuclear Physics, given by the division of nuclear physics. Koster was cited for "his measurement of bounds on time reversal invariance in polarized neutron transmission through aligned nuclei." Koster's thesis work, carried out at the Triangle Universities Nuclear Laboratory, showed the feasibility of searching for T violating terms in the forward elastic scattering amplitude by means of a cryogenically

aligned rotating holmium target.

Koster earned a PhD in nuclear physics from North Carolina State University in 1990 and then spent one year as a postdoc at Duke University before moving to Los Alamos.

The 1992 Forum Award, given by the APS Forum on Physics and Society to recognize accomplishments in promoting public understanding of issues in physics and society, went to Luis Masperi and Alberto Ridner of the Argentine Physics Association and to Fernando de Souza Barros and Luis Pinguelli Rosa of the Brazilian Physical Society. The four were cited for "laying the groundwork for the agreement between Argentina and Brazil to abstain from building any explosive nuclear device." As representatives of their respective physics societies, the four influenced the recent decisions of the Brazilian and Argentinian governments to sign an agreement in which both parties agreed to prohibit the testing, use, fabrication and purchase of nuclear arms.

Masperi, a former president of APA, is a scientist and the head of the theory division at the Atomic Center in Bariloche and a professor of physics at the Instituto Balseiro. He earned a PhD in physics from the Instituto Balseiro in 1969.

Ridner earned a PhD in physics from the Instituto Balseiro in 1970, after which he worked at the low temperature physics center at the Atomic Center in Bariloche. While serving in a postdoctoral appointment at Brown University in the late 1970s, he became interested in microcomputers, advanced-architecture computers and parallel computers. He now heads the scientific computer center at the Argentine National Atomic Energy Commission in Buenos Aires.

De Souza Barros, a former president of the Brazilian Physical Society, received a PhD in nuclear physics from Manchester University in England in 1960. From 1962 to 1965 he was a research physicist at the Carnegie Institute of Technology (now part of Carnegie Mellon University), and in 1966 he became an assistant professor of physics there. Since 1970 he has been a professor of physics at the Federal University of Rio de Janeiro.

Pinguelli Rosa, an elementary-particle physicist, is the chairman of the Forum for Science and Culture at the Federal University of Rio de Janeiro and a staff member of the graduate program in energy there. He earned a doctorate in physics from the Catholic University of Rio de Janeiro in 1974.

Kurt Gottfried, a professor of physics at Cornell University, is the recipient of the 1992 Szilard Award, also given by the Forum on Physics and Society. Gottfried was cited for his "timely and thorough analyses of the Strategic Defensive Initiative program, crisis stability of nuclear forces and conventional forces in Europe, which have contributed greatly to the understanding of these issues by government and the public." As a member of the Union of Concerned Scientists, Gottfried pushed for the application of physics to the UCS study of SDI. He also directed and organized studies of nuclear war and Soviet conventional forces under the auspices of Cornell.

Gottfried received a PhD in theoretical physics from MIT in 1955. After serving as a postdoc at Harvard and the Institute of Theoretical Physics in Copenhagen, he joined the Harvard faculty in 1960. He became a professor of physics at Cornell four years later and now serves as department chair.

OBITUARIES

Alan H. Barrett

Alan H. Barrett, a professor of physics at MIT, died on 3 July 1991 in Denver, Colorado, after a two-year struggle with cancer. He was 64 years old.

Barrett was born in Springfield, Massachusetts. After serving in the US Navy, he studied electrical engineering at Purdue University. He did his graduate work in physics at Columbia University with Charles Townes, specializing in microwave spectroscopy. He received his PhD in 1956 for a study of the microwave spectrum of the halides of indium and gallium.

Eager to apply his knowledge of spectroscopy to the new field of radioastronomy, Barrett began such work as a postdoctoral fellow at the US Naval Research Laboratory. While at NRL he made his first search for interstellar OH radicals, with A. Edward Lilley. He also became interested in planetary atmospheres after he learned from Cornell Mayer that observations of Venus at a wavelength of 3 cm indicated a surprisingly high temperature.

From 1957 to 1961 Barrett was a research associate and instructor in the department of astronomy at the University of Michigan. In 1960 he proposed a model to explain observations of Venus that indicated brightness temperatures of 600 K at wavelengths longer than 3 cm but of only 300 K at shorter wavelengths. In Barrett's model Venus's surface was hot and the atmosphere consisted of a thick layer of carbon dioxide, which gave rise to pressure-induced absorption and a greenhouse effect. Barrett was the principal investigator on the Mariner II flyby mission to Venus, which produced radiometric data that confirmed his model. In the mid-1960s Barrett and his colleagues led the development of remote sensing of the temperature and water-vapor structure of the Earth's atmosphere, first from balloons and later from dedicated satellites. In 1961 he joined the faculty of the department of electrical engineering at MIT, and in 1967 he was appointed professor of physics. Much of his research was carried out in the MIT Research Laboratory of Electronics.

In 1963 Barrett and colleagues discovered two 18-cm lambda-doublet lines from OH radicals in the interstellar medium by their absorption of the broad-band synchrotron emission from the supernova remnant Cassiopeia A. It was the first radio detection of an interstellar molecule at radio wavelengths. They later discovered that sources of OH emission were highly polarized, a key piece of evidence that led to their identification as natural masers—intense sources of radiation analogous to lasers. Barrett also helped develop very-long-baseline interferometry, a method of linking radiotelescopes separated by thousands of miles so that they would have the resolving power of a single telescope nearly as large as the Earth. This technique has since allowed fundamental advances in the study of quasars, galaxies and interstellar masers. In 1968 Barrett and his student William Wilson discovered hydroxyl

Alan H. Barrett