Nine physicists honored with E. O. Lawrence Awards

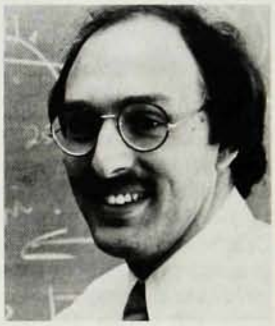
MALINAUSKAS

MILLER

NYGREN

OSBOURN

WEAVER



CONN

HAGELSTEIN

LAUGHLIN

HECKER

The US Department of Energy has named the following individuals to receive the 1985 E. O. Lawrence Awards: Anthony P. Malinauskas (Oak Ridge National Laboratory), William H. Miller (University of California at Berkeley), David R. Nygren (Lawrence Berkeley Laboratory), Gordon C. Osbourn (Sandia National Laboratory), Thomas A. Weaver (Lawrence Livermore National Laboratory) and Betsy M. Sutherland (Brookhaven National Laboratory). The Department of Energy last year presented the E. O. Lawrence Awards to the following six individuals: Robert W. Conn (University of California at Los Angeles), Peter Hagelstein (Livermore), Robert Laughlin (Livermore), Siegfried S. Hecker (Los Alamos National Laboratory), John J. Dunn (Brookhaven), and Kenneth N. Raymond (University of California at Berkeley and Lawrence Berkeley Laboratory).

Malinauskas was cited for "his outstanding contributions to the analysis of the movement of fission products in nuclear reactors, particularly light-water reactors." Malinauskas joined Oak Ridge in 1962 after receiving his PhD from MIT. He became leader of the gas-transport-properties group in 1966 and in 1973 he became head of the chemical development section in the chemical technology division. Malinauskas helped develop the early, mathematically rigorous "dusty gas" model of gas transport in solids. He pioneered experiments based on thermal transpiration to measure the energy-transfer efficiency between translational and rotational degrees of freedom in inelastic molecular collisions. In 1969 he and his coworkers pointed out that "oxyhydroxides" could form in some specific nuclear-reactor-accident scenarios, thereby enhancing the volatility of certain fission-product oxides. He has studied fission-product release and transport phenomena in high-temperature gas-cooled reactors, molten-salt reactors and light-water reactors. In 1980 Malinauskas, David O. Campbell (Oak Ridge) and William R. Stratton (Los Alamos) accounted for the anomalously small quantity of radioactive iodine released in the Three Mile Island accident by demonstrating that the most likely fission product was an iodide, not elemental iodine as had been assumed in previous accident-consequence analyses involving light-water reactors. Since 1983, Malinauskas has been director of Nuclear Regulatory Commission programs at Oak Ridge.

Miller was cited "for the development of an advanced mathematical-physics technique to describe the collisions of atoms and molecules." Miller received his PhD from Harvard University in 1967. He became an assistant professor of chemistry at the University of California at Berkeley and a senior scientist in the materials and molecular research division at Lawrence Berkeley in 1969. He was made a full professor in 1974. In the early 1970s Miller developed a general semiclassical theory of inelastic and reactive scattering (the "classical S-matrix") that has had broad impact in chemical physics and has also found use in nuclear and particle physics. In addition to showing the semiclassical origins of quantum effects (interference and tunneling) in collision processes, his work had the practical importance of clarifying and extending the utility of classical trajectory methods; he published classic reviews of the subject in 1974 and 1975. In the late 1970s Miller wrote an influential series of papers on extensions of transition-state theory, and in the 1980s he has developed a comprehensive framework, the "reaction path" Hamiltonian, for describing state-specific reaction dynamics in complex molecular systems.

Nygren was cited "for the development of experimental techniques in particle physics, and especially for the invention of the time-projection chamber." Nygren received his PhD from the University of Washington in 1967. As a research associate and assistant professor at Columbia University (1967–75) he worked with Jack Steinberger (now at CERN) on studies of K-long decays and CP violation; in 1973 they reported the first observation of the extremely rare decay $K^0_L \rightarrow \mu^+\mu^-$. After joining Lawrence Berkeley as a divisional fellow (1973) Nygren became interested in the problems associated with reconstructing the complex event patterns anticipated for collisions in the SLAC–LBL electron–positron collider PEP. Building on the particle-detection techniques available, especially those developed by George Charpak and his group at CERN, Nygren introduced the time-projection-chamber concept in early 1974 (see PHYSICS TODAY, August 1984, page 36). The PEP-4 facility, first operated in 1981, has now reached its expected performance in track resolution and particle identification. Nygren is now working on a new high-resolution drift-chamber concept and is coordinating efforts to develop a long-range advanced-detector development program at the laboratory.

Osbourn was cited "for his work in the field of strained-layer superlattices... [and] the first theoretical calculations predicting their unique electrical and optical properties." Osbourn received his PhD from Caltech in 1979; he then joined Sandia National Laboratories in Albuquerque, New Mexico. Osbourn was the first to propose that superlattices made from thin mismatched semiconductors could have useful and tailorable electrical and optical properties, and he predicted a series of these properties. In 1982 he proposed that the band gap and lattice constant of a strained-layer superlattice could be independently varied; he sugested that the inherent strain could be used to reduce the band gap of certain infrared strained-layer superlattice materials. He predicted new direct-band-gap semiconductors that could be fabricated from indirect-band-gap layered materials. In addition, he proposed in 1984 that inherent strain could be used to reduce the effective mass of holes. Osbourn has been division supervisor at Sandia since 1983.

Weaver was cited "for his exceptional contributions to national security in x-ray laser experiments. He is also known for his research in astrophysics, with particular emphasis on the evolution of stars." Weaver received his PhD in 1975 from the University of California at Berkeley for a study of deuterium synthesis in supernova explosions. He pioneered studies of strong shock waves and the associated nucleosynthesis in stellar explosions. In 1975 Weaver joined Livermore, where he made major contributions in designing the x-ray laser. He further supervised much of the corresponding experimental program, including the fabrication of materials and the assembly of diagnostics. Weaver served as the first leader of the Livermore x-ray-laser program (R-Program) in 1981–85. He is now the program's chief scientist, in which position he continues his work on the design and scaling of x-ray-laser systems with defense and research applications. In addition, he and Stanley Woosley (University of California at Santa Cruz) have been studying nucleosynthesis in type-1 supernovae.

Conn was cited "for his pioneering contributions to fusion reactor engineering and for his articulate representation of the engineering needs of fusion." Conn received his PhD from Caltech in 1968. He held research positions at the Euratom Community Research Center in Ispra, Italy (1968–69) and at Brookhaven (1969–70) before joining the faculty of the University of Wisconsin in 1970, where his initial research on magnetic fusion reactors resulted in the UWMAK I, II and III and NUWMAK tokamak conceptual reactor designs. Conn served as director of the Wisconsin fusion-technology program for 1974–80. In 1976 he began studies of the laser fusion reactors SOLASE and SOLASE-H. Conn introduced the concept of "tailoring" fusion-reactor materials to lower their induced radioactivity levels in 1978. In 1979 he developed the pump limiter, an efficient and simple means of exhausting plasma and controlling the plasma density in tokamak machines. Conn has been a member of the Fusion Advisory Panel to the Committee on Energy Research and Production of the House of Representatives since 1979 and a member of the DOE Magnetic Fusion Advisory Committee since 1982. Conn became a professor of engineering and applied sciences at University of California, Los Angeles, in 1980.

Hagelstein was cited "for exceptional contributions to national security through his innovation and creativity in x-ray laser physics, including the prolific conception of x-ray laser schemes, the analysis of x-ray lasing phenomena and the creation of extraordinary computational modeling roles." Hagelstein received his PhD in 1981 from MIT. He began working on a part-time basis at Livermore in 1975, and in 1981 became a member of the full-time staff. The physical computational models that Hagelstein developed to calculate the energy levels and relaxation mechanisms of multiply ionized atoms, such as the lithium-like and beryllium-like ions, led to the development of the nuclear-explosion-driven x-ray laser. Since 1976 he has developed the XRASER computer code for calculating such quantities as populations of electronic energy levels and light amplification in the design and analysis of x-ray laser schemes. Hagelstein was group leader of computational physics at Livermore for 1982–85.

Laughlin was cited "for his demonstration that correlated motion of electrons can lead to a previously unknown form of quantum liquid, thereby providing an understanding of the fractional quantum Hall effect." Laughlin received his PhD from MIT in 1979. He held a postdoctoral position at Bell Laboratories in Murray Hill, New Jersey (1979–81), before becoming a research physicist at Livermore. In 1983 Laughlin proposed a fundamental explanation of the quantized Hall effect, in which a two-dimensional electron gas maintained at low temperatures in an intense magnetic field exhibits a Hall conductivity equal to a fractional multiple of e^2/h. He demonstrated that unlike in the integral Hall effect, in which the Hall conductivity of an electron gas is quantized to integral multiples of e^2/h, the much larger magnetic fields necessary to produce the fractional effect actually cause the electrons to condense into an incompressible quantum liquid with fractionally charged excitations (see PHYSICS TODAY, July 1983, page 19).

Hecker was cited "for his contributions to diverse fields of materials science including important contributions to the physical metallurgy and mechanical properties of plutonium metal and its alloys, as well as outstanding experimental contributions to the understanding of plasticity at large strain and high strain rates including plastic instabilities." Hecker received his PhD in metallurgy from Case-Western Reserve University in 1968. He then held a postdoctoral position at Los Alamos (1968–70) and a research position at General Motors Research Laboratories (1970–73). At General Motors he developed a technique for obtaining failure-limit curves for metals subjected to multiaxial stress. Hecker returned permanently to Los Alamos in 1973. There he has studied large-strain deformation, plastic instability, and the phase stability and mechanical behavior of plutonium alloys. Hecker is now chairman of the Center for Materials Science at Los Alamos.

Sutherland, a biochemist, is the first woman to receive the Lawrence Award. She was cited "for her analyses of the consequences of damage repair in bacteria and human cells exposed to ultraviolet light."

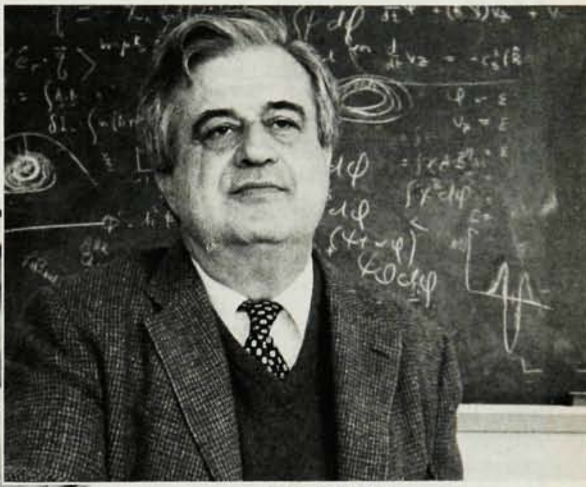
Dunn, a molecular biologist, was cited "for his fundamental contributions of great potential importance in determining modes of radiation damage and to the understanding of mechanisms by which DNA is transcribed and processed into functional messenger RNA."

Raymond, an inorganic biochemist, was cited "for elegant experimental characterization of the microbial iron transport process and extension to the synthesis of actinide sequestering agents of potential importance to the removal of plutonium from the body."

Rasmussen and Rosenbluth receive Fermi Prize

The 1985 Enrico Fermi Prize, the highest scientific award given by the US government, will be shared by Norman C. Rasmussen (MIT), for developing risk-assessment techniques used in safety analyses of nuclear power plants, and Marshall N. Rosenbluth (University of Texas at Austin), for contributing to the understanding of controlled thermonuclear fusion, particularly plasma stability and confinement. The prize is awarded by the Department of Energy in recognition of "exceptional and altogether outstanding scientific and technical achievement in the development, use and control of atomic energy." Although Fermi himself got only \$25 000 when the award was first made in 1954, since last year each prize winner receives a Presidential citation, a gold medal and a \$100 000 check.

RASMUSSEN



ROSENBLUTH

The awards will be presented in a ceremony on 6 February at DOE's Washington headquarters in the Forrestal Building.

Rasmussen is best known as the author of *Reactor Safety Study: An Assessment of Accident Risks in US Commercial Nuclear Power Plants*, more commonly known in reactor circles as WASH-1400. The report was prepared by a study group on light-water-reactor safety headed by Rasmussen at the request of the Atomic Energy Commission, the agency that later evolved into DOE. Since its publication in 1975, WASH-1400 has served as the basis for analyzing the risks of severe accidents for inclusion in the environmental-impact statement for each power reactor built in the last decade.

The probabilistic risk-assessment technique devised by Rasmussen provides a systematic approach to a variety of possible accident sequences at nuclear power plants. When environmental activists raised objections to Rasmussen's methodology, Congress directed the Nuclear Regulatory Commission to conduct an objective study of WASH-1400. The report of the study group, headed by Harold W. Lewis (University of California at Santa Barbara), found that WASH-1400 was:

> a substantial advance over previous attempts to estimate the risks of the nuclear option. The methodology has set a framework that can be used more broadly to assess choices involving both technical consequences and impacts on humans. WASH-1400 was largely successful in three ways: in making the study of reactor safety more rational, in establishing the topology of many accident sequences and in delineating procedures through which quantitative estimates of the risk can be devised for those sequences for which a data base exists.

Though their review questioned some of the statistical data in WASH-1400 and criticized NRC for dragging its feet in making full use of it, the Lewis panel concluded that it led to a rethinking of the nature of reactor hazards and a redirection of safety research, reactor design and plant practices. Probabilistic risk assessment is now widely used in nuclear-regulatory procedures to help decide on such matters as plant modification, maintenance and operation.

Rosenbluth studied under Edward Teller and Fermi at the University of Chicago, receiving a PhD in physics in 1949. He then went to Los Alamos, where he contributed to the design of the first thermonuclear weapons. Upon leaving Los Alamos in 1956, he joined the General Atomic Laboratory, which was then a prime mover in controlled-fusion R&D. In 1960, while at General Atomic (later renamed GA Technologies), Rosenbluth joined the faculty of the University of California at San Diego. He moved to Princeton in 1967 as professor at the Institute for Advanced Study and senior research physicist at Princeton University's Plasma Physics Laboratory. Since 1980 he has been the director of the Institute for Fusion Studies, University of Texas at Austin.

Among plasma physicists, Rosenbluth is considered an outstanding theorist. He was one of the first to penetrate the instabilities that plagued attempts in the 1950s to create stable plasmas. He suggested ways of avoiding these instabilities that led, along with Soviet contributions to the field, to designs for what are now the principal configurations for fusion research, the tokamaks.

Rosenbluth's work spans virtually the entire history of fusion research.