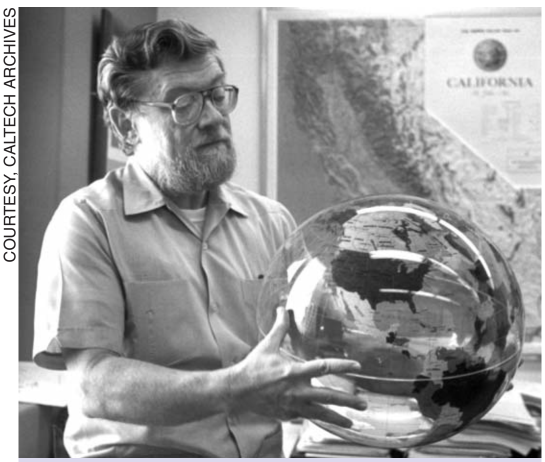
To notify the community about a colleague's death, subscribers can visit http://www.physicstoday.org/obituaries, where they can submit obituaries (up to 750 words), comments, and reminiscences. Each month recently posted material will be summarized here, in print. Select online obituaries will later appear in print.

Don Lynn Anderson

Don Lynn Anderson, professor emeritus of geophysics at Caltech and former director of its Seismological Laboratory, died on 2 December 2014 of esophageal cancer at his home in Cambria, California. Don was one of the most influential figures in 20th-century solid-Earth geophysics, and his work and leadership vastly advanced our understanding of the origin, composition, structure, and dynamics of Earth and the terrestrial planets. In his quest to understand Earth's interior, Don delved into every relevant branch of physics and Earth science, including petrology, geochemistry, planetary science, and solid-state physics. He was honored with the highest medals of the American Geophysical Union, the Geological Society of America, the Royal Astronomical Society, and the German Geophysical Society. In 1998 he also received the US National Medal of Science and the Crafoord Prize in Geosciences of the Royal Swedish Academy of Sciences.



COURTESY, CALTECH ARCHIVES

Don Lynn Anderson

Don was born on 5 March 1933 in Frederick, Maryland, and liked to claim that in honor of his birth President Franklin D. Roosevelt had proclaimed a 10-day banking holiday. Like many of Don's pronouncements, that one had a hidden meaning—the danger of mistakenly attributing statistical significance to a coincidence.

After obtaining a bachelor's degree in geology and geophysics from Rensselaer Polytechnic Institute in 1955, Don worked for a year for Chevron. He then joined the US Air Force Cambridge Research Laboratories and worked with Wilford Weeks studying elastic waves in floating sea ice off Thule, Greenland, to determine whether landing large airplanes on the ice was safe. In that work, he developed the theory of elastic waves in anisotropic media, which later proved essential to understanding Earth's mantle, crust, and inner core.

Don began graduate work at Caltech in 1958. He earned a PhD in geophysics in 1962 when his adviser, Seismo Lab director Frank Press, unexpectedly told him that his new manuscript on elastic waves in layered anisotropic media would largely fulfill the thesis requirements. He stayed on as a research fellow and rose through the ranks of assistant, associate, and full professor in 1963, 1964, and 1968.

During that period, seismology advanced rapidly because of developments in computing and instrumentation that were spurred by government interest in detecting and identifying underground nuclear explosions. It became possible to measure accurately the dispersion of surface waves with periods of hundreds of seconds, which are sensitive to conditions at depths of hundreds of kilometers, and to compare the result with theoretical predictions. Those comparisons established the reality of a global low-velocity zone in the upper mantle and thereby resolved a long-standing controversy.

Don recognized that although surface-wave dispersion lacked adequate resolution at those depths, body-wave observations made possible with new instruments, particularly seismometer arrays, were ideal for studying the transition zone. However, this required that later-arriving branches of travel-time curves be treated on an equal footing with first arrivals. Collaborating with Lane Johnson, one of us (Julian), and Mansour Niazi, Don used body waves to study the structure of the transition zone and to demonstrate the reality of the two-discontinuity model.

Don hypothesized that the transition-zone discontinuities were caused by pressure-induced polymorphic phase transformations in minerals, and he realized that explaining the low-velocity zone and the transition zone required understanding the physics of rocks at high temperature and pressure. He expanded the Seismo Lab's scope to address those problems; he hired Thomas Ahrens to establish a shock-wave laboratory and put students Hartmut Spetzler, Charles Sammis, Hsi-Ping Liu, and others to work applying techniques such as ultrasonic interferometry, Brillouin scattering, and Raman scattering to the study of minerals.

Responding to a need for a "standard" model of Earth's interior elasticity and density, Don worked with Adam Dziewonski of Harvard University to generate the preliminary reference Earth model, or PREM, published in 1981. They chose the name to emphasize that knowledge in the field would always be in a state of flux, as became clear when in the middle of the work they concluded that the upper mantle in any adequate model had to be both elastically anisotropic and slightly anelastic on a global scale. Preliminary though it may be, PREM is still universally regarded as the standard Earth model.

Don spent the final quarter of his career studying Earth's fourth dimension—how the mantle evolves. He questioned in particular the popular hypothesis that some volcanic regions, such as Hawaii and Iceland, are caused by narrow thermal plumes rising from the deepest mantle. After several years studying the evidence for plumes, Don concluded that "nothing seemed to fit." He took up his final great scientific challenge, arguing that deep mantle plumes do not exist at all.

In collaboration with the other of us (Foulger), Don used the emerging internet to build an international, diverse group of colleagues; among the many contributors were James Natland, a geochemist at the University of Miami, and Dean Presnall, an experimental petrologist at the Carnegie Institution of Washington and the University of Texas at Dallas. With the underpinning of his favorite website, http://www.mantleplumes.org, he changed the subject from an assumption-driven endeavor to a question-driven one and opened many minds to the fundamentals of how we do science. Many of the questions he posed are still unresolved and today are the research subjects of choice for numerous scientists, young and old.

Don left us with a precious gift—a great new Earth science controversy. He also left us with the tools with which to address it—a wealth of knowledge and a legacy of superbly trained, deeply inspired students and colleagues to carry on striving for greater understanding of the internal workings of the planet on which we live.

Bruce R. Julian
Palo Alto, California
Gillian R. Foulger
Durham University
Durham, UK

Susumu Okubo

Renowned particle theorist Susumu Okubo passed away peacefully at his home in Rochester, New York, on 17 July 2015 after a brief struggle with cancer.

Born on 2 March 1930 in Tokyo, Okubo received his bachelor's and master's degrees in physics from the University of Tokyo before joining the University of Rochester as a graduate student in 1954. He received his PhD in theoretical physics in 1958, with David Feldman serving as his adviser. He was a research associate at Rochester from 1957 to 1959. He then spent 1959–60 at the University of Naples and the subsequent year at CERN. He also spent a brief period at the University of Tokyo before returning to Rochester in 1962 as a senior research associate, and in 1964 he became a professor of physics.

Okubo made seminal contributions to theoretical particle physics, and his insights led to a deeper understanding of physical phenomena. He came into the limelight when he proposed the mass formula for baryon and meson multiplets in the context of unitary symmetry, commonly referred to as the Gell-Mann–Okubo (GMO) mass formula. The known pseudoscalar and vector bosons and the spin-½ baryons belonged to octets of *SU*(3). Scientists believed that *SU*(3) must be a broken symmetry since there was no mass degeneracy in the baryon octet nor in the pseudoscalar or vector-boson multiplets. Okubo introduced an interaction Hamiltonian to break the mass degeneracy and derived a mass relation among the baryons in the octet of *SU*(3) that was satisfied to within 0.5% of the measured values.

One of the GMO triumphs was in the context of the mass relations in the spin-3/2 baryon decouplet. It predicted the existence of a 10th baryon in the rep-

Susumu Okubo

resentation, an isoscalar with strangeness −3 that had not yet been observed. Subsequently, experiment confirmed the existence of the Ω^- whose mass was in conformity with the GMO formula.

Another of Okubo's seminal contributions is the so-called Okubo-Zweig-Iizuka (OZI) rule governing decays of mesons through strong interactions. The rule was introduced to accommodate the decay of the φ meson belonging to the vector-boson multiplet of *SU*(3). The experimental observation that φ decayed predominantly to $K\bar{K}$, with its 3π decay mode suppressed, was puzzling, since the available phase space for 3π decay is larger than that for the $K\bar{K}$ mode. Okubo observed that φ in its *SU*(3) assignment had only an $s\bar{s}$ quark content. According to the OZI rule, strong decays of φ to final states without strangeness were therefore not allowed. Okubo suggested that the vector bosons φ and ω mix, and since ω is composed of up and down quark–antiquark pairs, the physical φ acquires a small light quark content from φ–ω mixing, which leads to a suppressed $\varphi \to 3\pi$ decay.

Using current-algebra techniques, Okubo undertook a systematic study of the weak leptonic, semileptonic, and nonleptonic decays of hadrons even before the electroweak unified theory was proposed. He was first to find that partial widths can differ for charge-conjugate channels, and that finding influenced Andrei Sakharov's formulation of the three fundamental requirements for understanding the baryon asymmetry of the universe. In his paper, Sakharov recognized Okubo through a short verse: "From S. Okubo's effect, at high temperature, a fur coat is tailored, to fit the skewed form of the universe."

Among his other notable contributions, in 1959 Okubo proposed, with Augusto Gamba and Robert Marshak, the idea of baryon–lepton symmetry, which eventually led to the suggestion of neutrino mixing that plays a key role in neutrino oscillations.

Okubo's deep appreciation of group theory led to new ideas in the study of Lie groups and nonassociative algebras. His work on quaternions and octonions has proven quite useful in mathematics and theoretical physics. In parallel to the *SU*(3) of particle physics, he introduced a pseudo-octonion algebra that goes under the name Okubo algebra. Such algebras are quite fundamental and appear in mathematics and superstring theory. Okubo also was an outstanding researcher and teacher, and he supervised many graduate students at Rochester who achieved distinction in their own research.

Okubo was awarded fellowships from the Guggenheim Foundation in 1966 and the Ford Foundation in 1969. He received the 1976 Nishina Memorial Prize, the 2005 J. J. Sakurai Prize for Theoretical Particle Physics from the American Physical Society, and the 2006 Wigner Medal for his contributions to the understanding of physics through group theory.

Okubo loved to travel, was an ardent scuba diver, read voraciously, and tended to a Japanese garden at his home. He left a physics haiku as his death poem (*jisei no ku*) in the old Japanese tradition: "To be or not to be? Quantum Dream of the Schrödinger Cat. Farewell, Farewell Forever. Departure time now to the Black Hole. Never to Return. Farewell."

He was a unique and kind human being, who will be missed greatly by his family, friends, colleagues, and students, on whose behalf these few words are offered.

Ashok Das
University of Rochester
Rochester, New York

Robert Homer Simpson

Over a remarkable career spanning some 75 years, Robert Homer Simpson arguably contributed more than any other individual to observing, predicting, and warn-