



Philip Hauge Abelson

gressional Office of Technology Assessment (1979–92) and assistant for S&T (1993–98) to President Bill Clinton, I had many memorable conversations with Phil about the bright future of energy conservation. I saw it as an optimistic attitude about the power of technology to increase efficiency rather than a pessimistic view of the future of fossil fuels.

Phil's life was pervaded by an optimism about the power of science to provide new options and help shape a bright future. He enjoyed running—and I don't mean jogging or walking—up to the end. I'm certain that in his last days, he was full of plans to run a few more miles before preparing his next editorial. We will miss his wise perspectives and incisive voice for a long, long time.

John H. Gibbons
The Plains, Virginia

Louis Brown

Physicist and historian Louis Brown of the Carnegie Institution of Washington's Department of Terrestrial Magnetism (DTM) died from a heart attack on 25 September 2004 while he was leaving the opera in New York City. Lou had been an active researcher whose career spanned nuclear physics, the intersection of physics with isotope geology, and the history of science and military technology.

Born in San Angelo, Texas, on 7 January 1929, Lou studied physics at St. Mary's University in San Antonio and received his BS in 1950. He spent the next two years as an artillery lieutenant in the US Army; he regarded his military service as an

important part of his education. He completed his PhD in physics at the University of Texas at Austin in 1958.

Lou then accepted a postdoctoral position with the physics department of the University of Basel, Switzerland. He joined Hermann Rudin and one of us (Striebel) to design and build a source of polarized protons and deuterons for accelerator experiments in nuclear physics. The Basel team was the first to successfully produce a beam of polarized deuterons and won the university's Amerbach Prize for that work.

In 1961, Lou returned to the US as a staff member at DTM under director Merle A. Tuve. There, Lou installed a polarized proton source that he had designed in Basel to improve on the team's original effort. Until 1976, he directed Carnegie's nuclear physics program in collaboration with scientists from Basel and the University of Wisconsin–Madison. Program researchers focused on interactions of polarized protons with light nuclei that are important in hydrogen-burning stars.

Lou's wide intellectual curiosity and interest in novel instrumentation intersected with DTM's use of isotope systems to study Earth and space. Working with Roy Middleton (see his obituary on page 85 of this issue) and Jeffrey Klein at the University of Pennsylvania, and Fouad Tera, Selwyn Sacks, and one of us (Morris) at DTM, Lou was central to the earliest development of accelerator mass spectrometry. In a 1982 paper in *Nature*, Lou and coauthors reported an exciting application of extraordinarily sensitive accelerator mass spectroscopy: They were the first to measure concentration levels at a million atoms per gram of cosmogenic beryllium-10 in volcanoes from the Ring of Fire. Before that time, ^{10}Be was determined by beta-decay counting; new experiments elsewhere with cyclotron measurements had just begun. The method is now used worldwide for measuring many cosmogenic nuclides in biomedical, environmental, geological, meteoritic, and forensic samples. Lou published a series of papers exploring ^{10}Be systematics and their utility in the Earth sciences. Throughout his career, Lou was involved in the design and construction of mass spectrometers and, shortly before his death, of an ion-microprobe mass spectrometer.

In the 1990s, Lou's interests turned to writing history, particularly on the development of the proximity fuze during World War II and the invention of radar. He relished the worldwide contacts with old-time radar workers

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Louis Brown

that developed as he wrote his magnum opus, *A Radar History of World War II: Technical and Military Imperatives* (IOP, 1999). The work was hailed for its encyclopedic breadth, its balance, and its international scope. As noted on the book's back cover, Pulitzer Prize winner Richard Rhodes called it "a great book, of permanent value: powerful, magisterial, full of surprises and freighted with deep insight into science and human affairs." Lou's expertise was sought by curators at the Smithsonian Institution in Washington, DC, and at the Historical Electronics Museum in Baltimore, Maryland. As unofficial historian of DTM, he was instrumental in preserving the department's archives and its historic field and laboratory photographs. Sadly, Lou did not live to see the culmination of that work in print, but the *Centennial History of the Carnegie Institution of Washington. Volume II: The Department of Terrestrial Magnetism* (Cambridge U. Press, 2005) is a lasting tribute to him.

A hallmark of Lou's style was his joyful zest and vigor, both physical and intellectual. He was remarkably generous professionally, an attribute that led to many successful team collaborations, and he contributed unselfishly to the success of his younger colleagues. Lou's plan was to retire at age 65 to make room for a younger scientist, and then keep working, which is exactly what he did. Many colleagues were inspired by his intellectual breadth and scientific enthusiasm, which never waned.

Julie Morris
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Leslie Charles Hale

Leslie Charles "Les" Hale was a distinguished researcher in ionospheric physics and atmospheric electricity and a professor of electrical engineering at the Pennsylvania State University in University Park for 30 years. He died in Las Cruces, New Mexico, on 26 December 2003 of heart failure following complications from hip replacement surgery.

Born in Alamogordo, New Mexico, on 26 June 1932, Hale was raised primarily by his mother and was completely on his own at age 19. Two events in his early years planted important seeds for his subsequent professional career in electromagnetics and rocketry: when, at age 12, he read a copy of *QST*, a publication about amateur radio, and shortly thereafter, when he witnessed the launch of a captured German V-2 rocket from White Sands Proving Ground. Hale enjoyed being an amateur radio operator for the rest of his life, and he was principal investigator on more than 100 sounding rockets for the upper atmosphere and ionosphere, a US record.

Hale earned his BS (1952), MS (1954), and PhD (1958) all in electrical engineering, at the Carnegie Institute of Technology (now Carnegie Mellon University) in Pittsburgh. His doctoral thesis, supervised by James B. Woodward Jr, was entitled "Initial Excitation and Amplitude Rise in Electronic Oscillators."

After joining Los Alamos Scientific (now National) Laboratory as a member of a group of "space cadets" in the post-Sputnik era, Hale began his rocket-based space investigations there when he helped initiate one of the first missions to Venus. In 1962, he was a senior research fellow in space research at University College London. There, he met Arthur Waynick, founder of Penn State's Ionosphere Research Laboratory, and subsequently joined Penn State's electrical engineering faculty. During his first year at the university, he met Roberta MacMillan, his future wife, who would later assist him with the editing and typing of all his scientific papers. He remained at Penn State as the A. Robert Noll Distinguished Professor of Electrical Engineering for the duration of his career.

Hale's pioneering efforts with rockets included the use of retarding potential analyzers for "deep space" ionization measurements, the development of continuum-flow probe techniques for middle atmosphere ionization measurements, early mea-



Leslie Charles Hale

surements of nitrogen oxide in the middle atmosphere, and interpretation of "blunt probe" electrical conductivity data to indicate the importance of aerosol particles in middle-atmosphere ionization processes. His investigations in the late 1950s to early 1990s involved the challenging tasks of measuring middle-atmosphere electric fields during thunderstorms and during geomagnetically disturbed and quiet periods.

Hale reveled in bucking the conventional wisdom. One good example is when he put forth his own theory about the physical origin of the extremely low-frequency "slow tail," an electromagnetic feature radiated from lightning discharges. Robert Wattson-Watt and, later, James Wait held the view that dispersion of white noise produced by the return stroke and propagating in the Earth-ionosphere waveguide explained the slow tail. Ted Pierce followed by Marx Brook proposed that continuing current in the lightning return stroke was necessary for slow tails. Hale, though, emphasized Lee Tepley's observations that slow tails were too common to be explained by continuing currents and rejected their primary role. As an alternative to the ideas of Wait, Hale advanced the idea that the slow tail waveforms were controlled by the round-trip propagation delay between Earth and ionosphere. The jury is still out on this issue.

The most important contribution Hale made to atmospheric electricity and the global circuit was his persistent insistence on the AC aspects and the role of capacitive coupling (in his customary electrical engineering perspective) between lightning and the