OBITUARIES

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Sidney David Drell

NSF/PHOTO BY SANDY SCHAEFFER

Sidney David Drell

Sidney David Drell died on 21 December 2016 at his home in Palo Alto, California. He was a leading figure in theoretical particle physics and in public service, notably in his lifelong efforts to abolish nuclear weapons. An extraordinary mentor, his own included John Wheeler, his thesis adviser Sidney Dancoff, Victor Weisskopf, and Wolfgang "Pief" Panofsky. Albert Einstein was clearly a virtual mentor, in Sid's love of physics and of the violin and classical music.

Born on 13 September 1926 in Atlantic City, New Jersey, Sid graduated with a BA in physics from Princeton University in 1946. He did his graduate work in physics at the University of Illinois at Urbana-Champaign, followed by a postdoc at Stanford University and then by an assistant professorship at MIT.

His subsequent career had several phases, of which the three of us in turn share recollections.

Bjorken: My first encounter with Sid was as an MIT undergraduate physics major, when I benefited from evening seminars held in his home. We both emigrated from MIT to Stanford in 1956, where Sid sponsored my thesis. Together we wrote two textbooks, one on relativistic quantum mechanics and one on quantum field theory.

Another émigré in 1956 from MIT to Stanford was Burton Richter. The two spearheaded a program to test quantum electrodynamics at short distances, for which QED's validity was widely questioned. Sid's theoretical work led to a well-defined experimental program, which Richter immediately pursued.

In 1960 the proposal to build SLAC got off the ground, and Sid joined the effort early on. Sid contributed an important component of the experimental program via what became known as the Drell process. As the laboratory grew, a first-class theory group grew with it. Sid shaped its ambience in large part by encouraging a climate of informality and establishing high standards. He was a master at asking a speaker an apparently naive question that only after the discussion was over turned out to be not at all naive.

Sid's theoretical-physics resumé includes many major contributions. The majority are focused on the electromagnetic structure of hadrons. The most quoted is the "naive Drell–Yan formula," which describes how quarks and antiquarks in colliding proton or antiproton beams can produce dileptons. Created by Sid and colleague Tung-Mow Yan, it has a direct but subtle simplicity. Their simple result was embellished with the development of quantum chromodynamics and earned the "naive" label. I especially like the irony therein, because the concept of a naive Drell is downright unthinkable.

Sid served for 30 years (1969–98) as deputy director of SLAC. In that role he was especially valuable in smoothly bringing groups with divergent positions to a consensus.

Garwin: In a frank, insightful 1986 interview with Finn Aaserud for the American Institute of Physics, Sid recounted his involvement with JASON, a group of consultants to the US government. It began with the 1960 JASON summer study in Berkeley, California, and the 1961 study at Bowdoin College in Maine on the physics of atmospheric reentry. Those set the course of much of Sid's life in policy matters.

Sid and another JASON founding member, Mal Ruderman, worked on how high-altitude nuclear explosions affect satellite detection of strategic ballistic missile launches. At about the same time, Sid joined and ultimately chaired the Strategic Military Panel (SMP) of the President's Science Advisory Committee (PSAC). He created and chaired PSAC's Ground Warfare Panel and served as a PSAC member for four years.

In his JASON work, Sid cochaired the Small Undersea Mobile study on basing the large MX missile on small submarines. From about 1993 he led a series of studies for the Department of Energy and others that provided technical support for joining the Comprehensive Nuclear-Test-Ban Treaty and for safely and reliably maintaining US nuclear weapons without nuclear explosion tests.

President Richard M. Nixon's national security adviser, Henry Kissinger, annotated Sid's 1969 PSAC SMP report with "We must get PSAC out of strategy." This was despite the fact that Sid, as a member of a five-person informal panel of scientists, met with Kissinger monthly for two years to discuss classified papers the group prepared on technical and policy options for what became the 1972 Strategic Arms Limitation Talks (SALT) agreements with the Soviet Union. Those papers addressed nuclear-test limitations, options for constraints on missile defense, limits on multiple reentry vehicles, transparency, and the like.

After Sid immersed himself in 1963 in solving a problem with the Central Intelligence Agency's Corona film-return reconnaissance satellites, he was invited to join PSAC's Land Panel—named for its chairman, Edwin Land—on overhead reconnaissance. In that role, Sid helped eliminate the military program for a manned orbiting laboratory and was instrumental in the transition from film-return satellites to digital-imaging ones that radio their images to Earth. For those contributions, he was recognized in 2000 by the National Reconnaissance Office as one of the 10 founders of national reconnaissance.

Perry: I first met Sid 55 years ago, in 1962. President John F. Kennedy had just started the Arms Control and Disarmament Agency (ACDA), and I had signed up to be a pro bono consultant. There I

met two other consultants, Pief and Sid, and we decided to convene the first-ever conference on the use of sophisticated intelligence systems to verify arms control treaties. That began my long and fruitful collaboration with Sid and Pief, and I soon came to realize that the two men were giants in the field of arms control.

We helped the ACDA formulate its first treaty, SALT, but were unsuccessful in having the treaty organized around limiting warheads instead of missiles. Thus, to our dismay, the treaty encouraged the race toward multiple independently targetable reentry vehicles and an almost 10-fold increase in the number of deployed nuclear warheads. Indeed, it was not until the Strategic Arms Reduction Treaties I and II were signed in 1991 and 1993 that warheads were effectively limited, and the US had treaties that accomplished what we had sought in the original SALT.

Sid's deep interest in arms control led to his teaming with John Lewis to found Stanford's Center for International Security and Arms Control, one of the nation's leading security centers.

Sid had a long and close relationship with Andrei Sakharov. They met at a 1980s conference in Moscow, after which Sakharov invited Sid to his apartment and they talked into the night. Thus began a remarkable friendship and collaboration lasting until Sakharov's death in 1989. Sid then teamed up with Sergei Kapitza, a Russian physicist, to prepare *Sakharov Remembered* (Springer, 1991), a remarkable homage by scientists worldwide.

In his later years, Sid collaborated with George Shultz at Stanford's Hoover Institution. He organized a seminar held on the 20th anniversary of the Reykjavik Summit, where President Ronald Reagan and General Secretary Mikhail Gorbachev had explored the elimination of nuclear weapons. The two presidents failed to reach agreement, and 20 years later, Shultz, Kissinger, Sam Nunn, and I wanted to examine whether it was an idea whose time had come. After the seminar, we published an op-ed in the *Wall Street Journal* expressing our views. Sid was the driving intellectual force behind our series of op-eds, which highlighted the existential danger of nuclear weapons and called for their elimination.

For the three of us, working with Sid left an indelible mark. In his efforts with JASON, the Stanford arms control program, SLAC, and PSAC, Sid showed his dedication to the development of generations of physicists and public servants. Through it all, he served with his rich mix of wisdom, compassion, and humility.

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Edwin Leo Goldwasser

Edwin Leo "Ned" Goldwasser died on 14 December 2016. An excellent physicist, he loved science and shared that joy; conducted research at individual, large-group, and megascale accelerator-levels; and was passionate about human issues and the place of science in civil society. His broad contributions included not only innovative research and teaching but also international collaborations. His forte was promoting and realizing large-scale facilities for particle physics and other sciences.

Born in Manhattan, New York, on 2 March 1919, Goldwasser graduated from Harvard College with an AB in physics in 1940. During World War II, he served as a US Navy civilian physicist and developed methods to reduce ships' magnetic signatures to avoid mines. After the war he attended the University of California, Berkeley, and received his PhD in 1950 under Robert Brode. He accepted an invitation to join the University of Illinois at Urbana-Champaign.

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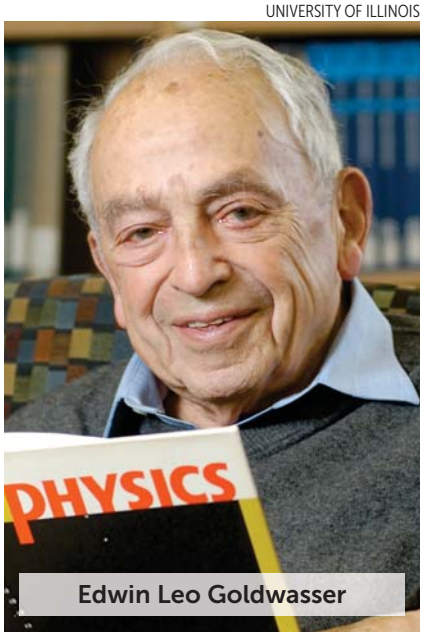

Edwin Leo Goldwasser

Goldwasser immediately launched new collaborations with other faculty. He and Gilberto Bernardini used the Kerst betatrons in Illinois to do a groundbreaking study of elementary-particle photo production at threshold. In Rome on sabbatical in 1957, Goldwasser conducted lectures in Italian, which he learned from Laura Fermi. When the Argonne Zero Gradient Synchrotron was completed in 1964, he took his research program to higher energies, helped build a bubble chamber, and founded and chaired its users' group.

A devoted teacher, Goldwasser led the Illinois part of the Physical Science Study Committee, a collaborative effort with MIT. Among Goldwasser's contributions was the influential textbook *Optics, Waves, Atoms, and Nuclei: An Introduction* (Benjamin, 1965). In 2007 the American Physical Society presented its inaugural Excellence in Physics Education Award to the committee for its "major and ongoing influence on physics education at the national level."

Goldwasser was a key advocate for building a hundred-GeV-scale accelerator. He served on the National Academy of Sciences site-selection committee for the proposed facility. In a letter to Edwin McMillan at Berkeley in 1964, Goldwasser wrote that "the actual control must be in the hands of an organization similar to AUI [Associated Universities Inc, which at the time managed Brookhaven National Laboratory] but national in its scope."

The National Accelerator Laboratory (later renamed for Enrico Fermi) was founded in 1967. Inaugural director Robert Wilson asked Goldwasser to be deputy director. Goldwasser took what became an extraordinarily extended leave from Illinois. Wilson and Goldwasser formed a tight triumvirate with Norman Ramsey, president of the Universities Research Association, the Department of Energy's prime contractor for the new laboratory. Together they managed most of the lab's construction and subsequent operations. The facility was brought in on time and on budget.

Perhaps most important to Gold-