WOLFGANG KURT HERMANN PANOFSKY

COURTESY OF SLAC NATIONAL ACCELERATOR ARCHIVES AND HISTORY OFFICE / DIANA ROGERS

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WOLFGANG K. H. PANOFSKY was born 24 April 1919 in Berlin and died, working at home, 24 September 2007. His diminutive, Pief, belied his status as a titan in spirit and in achievement. He was the son of the eminent art historian Erwin Panofsky, who immigrated to the United States with his family in 1934 to take a position as a professor at the Institute for Advanced Study in Princeton; as a Jew, Erwin Panofsky had been dismissed from his professorship at the University of Hamburg. Pief's brother, Hans Arnold, two years older than Pief, became an atmospheric scientist with a long career at Penn State. As youths in Hamburg the two brothers delighted in building complex toys from a Märklin construction set supplemented each year by their parents; among the products was an "automated vending machine to sell candy and cigarettes at exorbitant prices to their father's art history students at their seminars." Early on, Pief developed an aversion to art, but enjoyed and participated in music.

On their arrival at Princeton in 1934, Pief and Hans were admitted to the university on probation, not having graduated from high school. Pief obtained his B.S. in physics from Princeton in 1938, summa cum laude, and his Ph.D. in physics in 1942 from Caltech. That same year he married Adele DuMond, elder daughter of his thesis sponsor Jesse W. M. DuMond, and was granted U.S. citizenship, ending his anomalous status as an enemy alien with security clearance. He was swept up in the war effort and wrote his parents, "Our life is occupied by sleep, work, and babies. About work I am not allowed to write, about sleep I know nothing, and therefore this letter will deal with babies."[1]

With Alex E. S. Green, Pief devised an aircraft-towed "firing-error indicator" for the training of anti-aircraft gunners; this transmitted by radio the acoustic pulse from a microphone in the towed banner, thus allowing a precise determination of the projectile miss distance. He then joined the nuclear weapon program at Los Alamos, commuting from Caltech.

At Los Alamos, at the request of Luis W. Alvarez, leader of the "detonation" group there, he used similar technology to build an atmospheric pressure transducer that would be dropped with the nuclear weapons at Hiroshima and Nagasaki, to hang from a parachute at the time of the explosion and to transmit by radio to a chase plane the pressure wave from the explosion, thus allowing a determination of the explosive yield and the height of burst.

At the war's end, Alvarez returned to the University of California Radiation Laboratory at Berkeley and enticed Pief to accompany him.

1 The definitive and rich account of Pief's life is in his autobiography, *Panofsky on Physics, Politics, and Peace: Pief Remembers* (Springer Science+Business Media, LLC, 2007).

Alvarez called Pief his "secret weapon," but not too often, lest the secret get out.

Pief did pioneering particle physics research with the 184-inch synchrocyclotron and 330 MeV electron synchrotron at Berkeley, establishing in a June 1950 publication with Jack Steinberger and J. Stellar the decay mode of a neutral pion as two gamma rays in opposite directions (in the pion rest frame).[2] He then worked with Alvarez on the so-called Materials Testing Accelerator (MTA) with the goal of producing plutonium for an expanded nuclear weapons stockpile, in view of a low estimate of available uranium ore for building plutonium-production reactors or making enriched uranium. The goal of the accelerator was to produce a gram of neutrons per day.

At the time of the unrest in the University of California system over the loyalty oath in 1949, Pief signed but expressed his dismay and took a position at Stanford University, home of electron linear accelerators fed by high-power klystrons that had emerged from developments during World War II. Pief showed his outstanding talent and energy in working to extend and complete the MARK III accelerator and to carry out a vigorous research program with one of its two beams—the other being devoted to the work of Robert Hofstadter and his group studying electron scattering on various nuclei, for which Hofstadter was to receive a Nobel Prize in 1961; by then the MARK III was operating at 900 million electron volts (900 MeV) of electron energy.

Buoyed by the evident success of the MARK III, Pief, Hofstadter, and others considered "next steps," and did not think small. They proposed to build a two-mile linear accelerator—Project-M (for "Monster")—that was to accelerate electrons through 20 billion volts. This was an energy per particle of 20 giga-electron volts—20 GeV.

This audacious effort was criticized by some physicists because of the absence of strong interactions by electrons; how would one learn anything fundamental even from a high-energy, high-current electron accelerator? The Monster proposal won support, and the proposed accelerator was built by Pief and his team as the Stanford Linear Accelerator Center—SLAC.

Some in the Stanford physics department did not take kindly to this enormous project, and opposed positions in the physics department for leading staff of SLAC, opposition that was overcome only after years of experience and outstanding research results from SLAC. Pief was an inspired director and leader, with a hands-on approach that delighted and sometimes frustrated the staff recruited to build the accelerator as

2 For an appreciation of Pief's work in physics, and much else, see National Academy of Sciences, "Wolfgang Kurt Hermann Panofsky. 1919–2007. A Biographical Memoir," by Sidney D. Drell and George H. Trilling (2010).

a national facility operated by Stanford University for the federal government.

Although Pief's accomplishments in building and leading SLAC were recognized by the award of the National Medal of Science, the Enrico Fermi Award, the Ernest O. Lawrence Award, and the Leo Szilard Award, his contribution is measured also by the three Nobel Prizes awarded for particle physics work at SLAC, including the positron-electron colliding-beam storage rings and the synchrotron radiation from the storage rings. The accelerator no longer does particle physics, but SLAC is going strong, accelerating electrons for synchrotron radiation sources and, with the accelerator driving free-electron lasers, providing intense light pulses measured in femtoseconds (thousandths of a trillionth of a second); for a 10 fs pulse the entire pulse of light is 3 micrometers long. After the initial operation of SLAC in 1967, on time, on budget, and exceeding its promised performance, Pief would respond to questions as to how long SLAC would be productive with "Ten years, unless someone produces a good idea." Evidently Pief's determination, energy, inspiration, and talent for persuading others paid off, not only in the specific technical design of the accelerator, but especially in the organizational model, the insistence on flexibility in the contract, and emphasis on openness and technical documentation.

Pief had two other lives—his family and the world of public service and national security. Pief and Adele had five children, eleven grandchildren, and three great-grandchildren, so that Pief would frequently show photos of his family, dubbing the complex the "fast breeder reactor."

In 1956 Pief published a textbook with Dr. Melba Phillips, who had been dismissed from her teaching position at Brooklyn College for refusing to name her colleagues in testimony to the House Un-American Activities Committee. *Classical Electricity and Magnetism* was highly regarded and widely used. The collaboration had the distinction that Panofsky and Phillips never met until long after the publication of the book. And this was before the days of email, FAX, or Express Mail.

Pief had a passion for doing things right and setting things right. He had enormous initiative and energy. As an undergraduate he organized an enterprise for collecting the very large quantities of food left over from the "eating club" lunches and delivering it to Princeton's largely black communities. In 1969, at the behest of David Packard, Pief became co-chair of the local branch of the Urban Coalition, with which he worked diligently for two years, especially on improving educational opportunities in neighboring East Palo Alto.

I worked with Pief most closely when we were both members of the President's Science Advisory Committee (PSAC) in the early 1960s, and especially and for much longer, members of the Strategic Military Panel (SMP) of PSAC. PSAC was a group of eighteen scientists or engineers that met for two days every month in what is now the Eisenhower Executive Office Building—EEOB—where it occupied a vast conference room, 206–208. The PSAC chair was the president's science adviser, beginning in 1957 with James Killian of MIT and extending through George Kistiakowsky of Harvard, Jerome B. Wiesner of MIT, Donald F. Hornig of Brown University, Lee A. DuBridge of Caltech, and Edward E. David Jr., of Bell Telephone Laboratories. Members served four-year terms—Pief from 1961 to 1964; in addition, he had previously been a panel member and continued to be, especially in matters of arms control and strategic weapons, particularly defense against ballistic missiles.

PSAC typically had ten panels active at any time, which for the most part met also two days every month and had one or two PSAC members and about eight non-PSAC experts, plus a couple of younger scientists who, it was hoped, would catch the bug and become heavily involved in PSAC activities or other public policy matters.

About his PSAC service, Pief noted, "My work on PSAC was very demanding on my schedule. The committee met in Washington on the first Monday and Tuesday of each month, and there were many additional meetings of subcommittees. . . . Because I had to teach freshman physics on Wednesday mornings, my wife would pick me up from my return flight to San Francisco on Tuesday evenings, drive to the Stanford lecture hall, and work with me to prepare the demonstrations needed for the next day's classes. We then went home, and early on Wednesday mornings I gave the lectures and accompanying demonstrations, usually to three classes in succession."

Indeed, this whirlwind Pief-Adele tango included snaring five washing machines in the local launderette to do the week's worth of washing.

In his PSAC activity, Pief was also key to the committee's work on arms control, including, especially, the 1963 Limited Test Ban Treaty and technical work on detection of nuclear explosions.

We worked together in Geneva in 1959 on international Technical Working Groups on detection of nuclear explosions underground, in the atmosphere, and in space.

With the formation of the Committee on International Security and Arms Control (CISAC) in 1980 under the auspices of the National Academy of Sciences, Pief was a leader in discussions with the Soviet counterpart group on all of these elements of international security—control of nuclear weapons, Comprehensive Test Ban Treaty, effectiveness and stability of ballistic missile defenses, and the like. Pief chaired

CISAC from 1985 to 1993, in 1988 opening bilateral discussions with Chinese counterparts organized by the Institute of Applied Physics and Computational Mathematics—IAPCM—the theoretical nuclear weapon design group in China.

Pief and Adele first traveled to China in October 1976 for a two-week tour sparked by Chinese interest in high-energy physics and formed lasting ties with Chinese scientists and eventually with military leaders, who facilitated the CISAC exchanges. Pief's advice for China to enter particle physics via an electron-positron collider bore fruit, with the signing in 1979 by Deng Xiaoping and Jimmy Carter of the U.S.-China Agreement on Cooperation in Science and Technology, with its first protocol in high-energy physics. Pief and SLAC played a major role in the design and construction of the Beijing Electron-Positron Collider—BEPC—and Pief was proud of being written, *by name,* into the annual agreements between the U.S. Department of Energy and the Chinese Academy of Sciences.

Quite independently, Adele interacted with Chinese paleontologists, based on a career that was launched by the discovery on 2 October 1964 of the fossil remains of a large sea creature in the excavation for the two-mile linac at SLAC. The find, of genus *Paleoparadoxia,* was complete and excellently preserved. The bones themselves are now at UC Berkeley, with plaster replicas on display at SLAC, as the first scientific discovery made at that laboratory.

When President Richard M. Nixon was elected in November 1968, he chose Henry A. Kissinger as his national security adviser. The White House was quite antipathetic to scientists, and particularly to PSAC as a competing source of power in the White House, and in February 1973 Nixon disestablished PSAC and the Office of Science and Technology as a "cost-saving measure." Kissinger's attitude toward PSAC is typified by his handwritten annotation on a secret (now declassified) document, January 1970, of the Strategic Military Panel of PSAC: "We must get PSAC out of strategy."

From early 1969 until 1973, however, Pief played a fundamental but little-known role as member of an informal advisory group of five[3] chaired by Harvard biochemistry professor Paul M. Doty, a personal friend of Kissinger's and his colleague at Harvard University, and also a PSAC member. Largely ignoring formal reports from PSAC, and reducing to the extent possible PSAC's involvement in national security matters, Kissinger was nevertheless persuaded by Paul Doty that he needed a small group that could be informed of ongoing arms control and

3 Paul M. Doty, Harvard; Sidney D. Drell, Stanford; Richard L. Garwin, IBM; W.K.H. Panofsky, Stanford; and Jack P. Ruina, MIT.

national security questions and could be relied upon to provide private advice in the form of study memoranda.

A routine soon developed, in which the Doty group met with Kissinger in the White House Situation Room (in the basement of the West Wing). At this evening meeting, the group would provide the (often top-secret) memorandum it had prepared during the previous month on the topic requested by Kissinger. Kissinger would think about it overnight, and the next morning at breakfast in the Situation Room would provide his comments and agree on a new topic for the next month.

The topics of these reports included the Comprehensive Test Ban Treaty, MIRVs (multiple independently targeted reentry vehicles), anti-submarine warfare, Continental Air Defense, the Advanced Manned Strategic Aircraft, and many more.

The work was facilitated because Pief and Stanford physics professor and SLAC deputy director Sidney Drell shared a cleared secretary and had in their office at SLAC a facility approved by the government for generation and storage of highly classified material. The centrality of this work with Kissinger was shown when in Moscow, on 26 May 1972, President Richard M. Nixon and General Secretary Leonid Brezhnev signed the ABM Treaty and the Limited Offensive Forces Agreement—both informed by, but not completely satisfactory to, Pief and his colleagues of the Doty Group.

The importance and frustrating character of this interaction is suggested by the 1974 quote from Kissinger, "If I'd realized what a MIRVed world meant, I would have been more serious about obtaining a MIRV ban."

In his work with the NAS CISAC, Pief was able to fully employ his energy, insight, and moral leadership in helping the United States, the Soviet Union/Russia, and China to limit and control their nuclear weapons and their strategic confrontation.

Pief will long be remembered and honored for his energy, ability, and dedication to family, physics, and country. His accomplishments were phenomenal and his impression indelible.

Elected 1985

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