Guide to
Wolfgang Kurt Hermann Panofsky Papers, 1932-2008
Collection SLAC003
SLAC National Accelerator Laboratory, Stanford University

Contact Information:
Archives, History & Records Office
SLAC National Accelerator Laboratory
2575 Sand Hill Road MS97
Menlo Park, CA 94025
Phone: (650) 926-5376
Email: slacarc@slac.stanford.edu
URL: http://www.slac.stanford.edu/history/

Contents

Descriptive Summary

Title: Wolfgang Kurt Hermann Panofsky Papers, 1932-2008

Collection Number: SLAC003

Creator: Panofsky, Wolfgang Kurt Hermann

Extent: 220 cubic feet

Repository: Stanford University. SLAC National Accelerator Laboratory. Archives, History & Records Office

Language: The material is primarily in English.

Abstract: The bulk of the collection consists of extensive administrative and professional correspondence and memoranda, subject files, minutes and reports, and other materials relating to Dr. Panofsky's responsibilities as Director of the Stanford Linear Accelerator Center (SLAC) and as an advisor to government and academia regarding high energy physics and arms control. Official records also include experiment proposals, contracts, budgets, and personnel materials. The collection also includes files from Dr. Panofsky's early years as a student, research physicist and professor of physics at Caltech, the University of California, Berkeley, and Stanford University.

Administrative Information

Access: The US government materials are restricted until they are 30 years old; Stanford administrative records are restricted until 20 years old. Portions of this collection are open for research; materials must be requested at least 5 working days in advance of intended use. Unprocessed records are open only to the records creators. Other restrictions on access may apply to records of a sensitive or confidential nature, or to records relating to ongoing research programs and activities.

Provenance: Records described herein were first transferred to the SLAC Archives in 1988-1989 by Professor Panofsky from his office at the Stanford Linear Accelerator Center. The following accessions are now part of these processed Wolfgang Kurt Hermann Panofsky Papers: 1990-008, 1990-009, 1991-024, 1992-063, 1993-011, 1993-017, 1997-010, 1997-011, 1997-019, 1999-020, 1999-034, 2000-023, 2000-027, 2000-062, 2001-007, 2001-008, 2001-009, 2002-027, 2002-040, 2002-041, 2004-014, 2004-018, 2004-019, 2004-021, 2004-026, 2004-027, 2004-048, 2004-049, 2004-050, 2005-004, 2005-021, 2005-023, 2005-028, 2008-082. Several boxes were moved from storage in 1993. Later records (post-1984) maintained in Panofsky's office relating to his then-ongoing interest and participation in science policy, accelerator development and arms control were accessioned as they were transferred by Panofsky’s office staff. An accession of files from Panofsky’s office was transferred by the Archives staff in late 2007 and included important/vital documents mixed with what was "current" or in use at the time.

Preferred Citation: Office of the Director, Wolfgang K. H. Panofsky Papers. Series title, Subseries title, container number, folder title. SLAC National Accelerator Laboratory, Archives History & Records Office, Menlo Park, CA

Processed by: Roxanne L. Nilan (who initiated the project and wrote the biographical note), Robin Chandler, Jean Marie Deken, Pennington Ahlstrand, Laura O’Hara, Jennifer McCann, Elizabeth Paris, and Dorothy Leung with assistance from Bryan Johnson, Irene Sanchez, Liam O’Hanlon, Erica Tsai, and Justin Li. This work was supported

in part by the Department of Energy contract DE-AC03-76SF00515 and by grants from the American Institute of Physics Center for the History of Physics.

Separations Note: Excess duplicates of unmarked reports or reprints of publications (several of which are readily available online) were discarded. Unmarked SLAC Library books and collections of more recent SLAC Publications were separated from Panofsky's collection. Security clearance documentation forms as well as administrative receipts and other reimbursement records were dispositioned according to governing records schedules. Security classified materials relating to Professor Panofsky's arms control work were transferred to secure storage under the auspices of the Archives, Lawrence Livermore National Laboratory (LLNL). Promotional materials from the Stanford Physics Department were donated to the Stanford University Archives

Biographical Note

Wolfgang K. H. Panofsky was a widely respected physicist, science advisor and Stanford University professor. This energetic, unusually accessible scientist and administrator combined knowledge of high energy physics with detailed, first hand understanding of the technology of accelerators. In 1984, the Stanford Linear Accelerator Center paid tribute to its retiring director with a two day "Pief-Fest." The diversity of participants from all ranks of university, laboratory and scientific life was emblematic of the range of Panofsky's contributions and reflected great affection for a man whose life had been so closely tied to the evolution of SLAC. In his opening tribute, theoretical physicist and laboratory colleague Sidney Drell noted:

> *I am amazed at the invariance principles that characterize all of Pief's actions and interactions. His optimism, his warmth, his patience, his integrity, his kindness, his courage, and his persistence -- like the gravitational constant or the fine structure constant -- haven't wavered or altered one bit during all these years. Neither have his clothes or his geometry. He has also pioneered the building of beautiful machines and created a great laboratory -- immodestly perhaps considered here the greatest high energy lab; he has been an inspired and inspiring teacher, and throughout his career has devoted himself unselfishly to effective, wise and innumerable contributions to science policy and budgetary considerations in Washington, and to improved international collaboration in science and the free flow of scientists and science across national and ideological boundaries.*[1]

Early Years

Born in Berlin, Germany, in 1919, Wolfgang Panofsky spent his first fifteen years in Hamburg. Panofsky grew up amid the "typical" middle class intellectual life of the University of Hamburg where his father, Erwin, was professor of Art History and contributed to the work of the Kunsthalle, or Art museum. The Panofsky home was filled with academic discussions of art and scholarship, and with growing concern at the rise of Nazism. With Hitler's rise to power, German universities were targeted as sources of dissent, and the first dismissals of Jewish professors were announced in the spring of 1933. Within a year, Erwin Panofsky took advantage of two offers from the United States where he had earlier served as a visiting professor. Accepting both positions, at New York University and at Princeton University, he moved the family to Princeton, New Jersey.[2]

In the fall of 1934, fifteen-year-old Wolfgang Panofsky and his sixteen-year-old brother entered Princeton University rather than undertake the more socially disruptive task of entering an American high school program. He quickly settled into university life, choosing physics, mathematics and Latin courses because they involved little written work in English. Just as quickly, he settled into American life. Learning how to drive, he spent his first summer traveling around the United States with his brother and a friend in a very un-European fashion-- in a '26 Buick simply "to see the country."

---

[1]Sidney Drell, "Pief Fest, August 1984" SLAC Beam Line 15:8 (August 1984) 4, 6.

[2]"W.K.H. Panofsky: Transcript of an Interview taken on a Tape Recorder by Charles Weiner on 15 May 1973," Center For History of Physics, American Institute of Physics (New York, 1973): Session One, 1, 7-8.

The Princeton physics department of the 1930's was small, with little exposure of undergraduates to nuclear physics. Panofsky gained invaluable shop experience, however, working in a small room in the basement of the physics building to build a high-pressure ionization chamber and an electrometer circuit to measure radioactive isotopes produced by the new cyclotron. Winding transformers and learning precision shop work, he learned "to get my hands dirty." His interest ranged freely, but the classic problems of electrodynamics caught his attention. During his second summer, he worked at the Radio Corporation of America (RCA) radio tube plant in Harrison, New Jersey, with Princeton friend Ray Emrich, who went on to spend 41 years as a professor of physics at Lehigh University. From this work, Panofsky wrote his first scientific paper on the relative importance of conduction to emission for oxide-coated cathodes. Following a junior year research paper on the vibration of a piano string, he completed his senior thesis with Professor Walker Bleakney on the behavior of high-pressure ionization chambers and their saturation characteristics.[3]

Graduating with his B.S. from Princeton in 1938, young Panofsky was encouraged by his professors to apply to graduate school. He narrowed his choices to Columbia and the California Institute of Technology, influenced not only by their fellowship possibilities but by an interview with Isadore Rabi in New York and a long letter from Robert Millikan telling him about life at Caltech. Panofsky's choice ultimately was based on his sense of adventure. New York City life held few attractions compared to far off California. "It was not in any way whatever related to the particular subject of research," he later commented. "I didn't have the slightest idea of what I was going to work on...I didn't even know who was on the faculty other than Millikan."[4]

At Caltech, Panofsky balanced a heavy course load with teaching. On a "crash basis," Panofsky and Carl Anderson wrote a textbook on electricity and optics for sophomores to replace an out-of-date Millikan text. Although never published, this text was used at Caltech throughout the war years by other teaching assistants. Nuclear physics remained a distant field. Although he took one class with C. C. Lauritsen and attempted a course with J. Robert Oppenheimer, he viewed himself as "an x-ray guy." By his second year, he was a regular member of the first floor laboratory of Jesse DuMond. Panofsky was impressed by DuMond's insistence that a good physicist must be able to do everything himself from scratch. "One of the main things -- sort of the main principle of the Lab -- was not to depend on anybody else for anything that goes into your final data." A man of his generation, DuMond knew little about electronics, however. Panofsky was converted from casual visitor to DuMond student and laboratory regular after showing his usefulness by building a complicated regulator to keep the voltage stable on an x-ray tube. He then worked on the shielding and alignment of a two-crystal spectrometer, and coaxed the big x-ray tube into operation.[5]

Panofsky inherited a very complicated interlocking experiment and apparatus. DuMond had designed it with hardware accumulated over many generations of graduate students, so Panofsky was faced with a complex of interacting, high-precision components scattered all over the building; a high voltage power supply; delicate crystal spectrometers; and a variety of problems with shielding, precision measurements, and poor vacuum. His task was not only to carefully regulate and operate the machinery but also to derive data, by iterative method, out of the actual observed x-ray yields and spectra. It had to work right, with no weak links, and it had to work with little reliance on DuMond who, with the United States' entry into the war, was in Washington D.C. much of the time. The result of this work was not only Panofsky's thesis, but an extraordinary experience in managing a complex experiment whose success required the application of both technical and theoretical knowledge.[6]

---

[3] Ibid. 16-19.

[4] Ibid. 28.

[5] Ibid. 33.

[6] Ibid. 32-34; Wolfgang K.H. Panofsky, "Determination of h/e by Means of the Short Wavelength Limit of the Continuous X-ray Spectrum at 20 kV." (April 1942). See also Panofsky, J.W.M. DuMond, H.N. Bailey, A.E.S. Green, 1941, "Preliminary Report on a Redetermination of h/e by the Short Wavelength Limit of the Continuous X-Ray Spectrum," Physical Review. 59 (1941) 219; Panofsky, Green and DuMond, "Further Experiments Concerning the Determination of h/e by the Short Wavelength Limit of the Continuous X-Ray Spectrum," Physical Review 60 (1941) 163; and Panofsky, Green and DuMond, "Determination of h/e by Means of the Short Wavelength Limit of the Continuous x-Ray Spectrum at 20-kV," Physical Review 62 (1942) 301.

In 1942, Panofsky received his Ph.D. from Caltech, and that same year he married Adele DuMond,[7] the eldest daughter of his thesis advisor. He also found himself designated an "enemy alien" under California's new Enemy Exclusion Act. Although the act clearly was aimed at Californians of Japanese descent, it also included all Italians and Germans. Panofsky was required to register and to be home before curfew and could not go more than five miles from his residence even though his "residence" (Caltech) was the site of classified military research. In addition to his ongoing research with DuMond, Panofsky taught classical mechanics and electronics to military personnel during evening (post-curfew) extension classes. Wending his way through a variety of special clearances and, eventually, his naturalization as an American citizen (expedited by Millikan), Panofsky sensed the insecurity of wondering who, after the Japanese, would next be interned in or evicted from California.

During the remaining years of the Second World War, Panofsky worked on various military problems. In 1942, DuMond received National Defense Research Council funding, first to develop a precision aerial camera for tracking moving targets, and, later for a "firing error indicator" for measuring the proximity of bullets to targets. DuMond quickly drew Panofsky into the work. Once again in charge of the actual project, Panofsky mapped several full- scale experimental test runs and completed the government reports as well as the main scientific publications. Luis Alvarez read those reports and in 1943 asked Panofsky to serve as a consultant to the Manhattan Project at Los Alamos. Working largely from Caltech, Panofsky became a consultant to the Project, developing an acoustic firing error indicator (or shock wave calibrator) for Alvarez.[8] These devices were used in real time to determine the yields of the Hiroshima and Nagasaki bombs. Panofsky observed the first "Trinity" nuclear explosion from a B-29 at a distance of 10,000 feet from the event.

Berkeley And The Radiation Laboratory

Panofsky first became acquainted with Alvarez's interest in linear accelerators while working with him on the Manhattan Project. After the war, Alvarez gathered together a team at the University of California's Radiation Laboratory to build the proton linear accelerator out of surplus radar sets and he offered a research assistantship to Panofsky. Although tempted by an offer from Bell Labs, Panofsky chose to stay on the West Coast. He took a chance on the non-academic position at the Berkeley Radiation Laboratory where the Alvarez group would include Frank Oppenheimer, H. Bradner, Larry Johnson, John Woodyard, C. M. Turner and others.[9]

Alvarez was impressed at how quickly Panofsky picked up knowledge about cavities and wave guides. "He had no contact with microwave radio during the war," Alvarez wrote to Physics Department chairman Raymond Birge, "but he's now giving a lecture course on the theoretical and practical aspects of that field, and I'm with him a good part of each day, and I haven't the slightest idea where he finds the time [to learn it]..." Birge was looking for good men to teach physics. The majority of tenured physics faculty at Berkeley were attached to the Radiation Lab and supported by outside funds, with little or no teaching responsibilities on campus. When Birge found that Panofsky would be available at 8 a.m. to teach, he offered him a faculty position as assistant professor of physics (June 1946). Otherwise little involved in campus affairs at that time, Panofsky took his teaching seriously. His first course was a three-unit class in electrodynamics where he again discovered textbook problems: this time the issue was that a second volume of the required text was available only in German. At first, Panofsky wrote a mimeographed textbook that he used in teaching graduate courses. When colleagues expressed interest in a published version, and at the suggestion of E. U. Condon,

---

[7]Adele would later dedicate years to reassembling the fossil skeleton of a 10-million-year-old marine mammal (Paleoparadoxia, reclassified as Neoparadoxia repenningi) unearthed at SLAC in October 1964, during the excavation for the linear accelerator beam switchyard. (Panofsky, Adele I. "Stanford paleoparadoxia fossil skeleton mounting," SLAC-PUB-7829, 1988.)

[8]Panofsky, J.W.M. DuMond, E.R. Cohen, E. Deeds, "A Determination of Wave Forms and Laws of Propagation and Dissipation of Ballistic Shock Waves," Journal of Acoustical Society of America, 18 (1946) 97.

[9]L. W. Alvarez, H. Bradner, H. Gordon, W.K.H. Panofsky, C. Richman and J.R. Woodyard, "Berkeley Proton Linear Accelerator," UCRL-236 (November 1948) and Alvarez, Bradner, Jack V. Franck, Gordon, J. Donald Gow, Lauriston C. Marshall, Frank Oppenheimer, Panofsky, Richman, and Woodyard, "The Berkeley Proton Linear Accelerator," (UCRL, 1955; published in Review of Scientific Instruments 26 (1955) 111.

Panofsky collaborated with Melba Phillips, an expert in electrodynamics, to write and publish Classical Electricity and Magnetism. He was promoted to associate professor in the Physics Department in 1948.[10]

Harkening back to the teachings of DuMond, Panofsky maintained a holistic and hands-on approach. "Physics is the whole thing, which hopefully incorporates as much understanding as one can of the instruments which one uses," he later noted when speaking of this period. Panofsky's ability to organize complex scientific operations was put to good use. While working on high power RF problems and orbit theory, he also served as a coordinating deputy to get things done on a day-to-day basis including overseeing shop work, supervising operators, fixing the machine and working with the engineers on additional design work. Panofsky was called on to do design work on the Bevatron and the electron synchrotron, and from late 1949 into 1950 designed and built the linear accelerator components for E. O. Lawrence's controversial "Materials Testing Accelerator" (MTA) project.[11]

Panofsky enjoyed the sense of excitement at Berkeley and took good advantage of the array of machines available. Within the larger laboratory organization, there were no organized experimental groups, "no trappings of organized life," but rather 'the Alvarez principle,' that is "as reward for having built machines, any physicist should have opportunity to do experiments. The concept of an experimental group as it later prevailed simply wasn't in existence. So, we were simply physicists, and I was an assistant professor, and there were graduate students, and the graduate students then, as they do now, had to sign up and work for somebody."[12] Panofsky focused on a series of experiments to uncover the fundamental nature of the pi-meson and, in another series of tests, to probe the connections between these pi-mesons and the electromagnetic field. With Lee Aamodt and Jim Hadley, he produced key experiments analyzing the products of gamma-ray absorption in hydrogen and deuterium which determined the parity of the pi mesons, showed that neutral pi's were lighter than charged pi's and determined accurate pion masses, introducing the term "Panofsky ratio" into the literature.[13] He collaborated with Jack Steinberger to identify the neutral pi's produced in the electron synchrotron by observing the two decay gamma-rays in coincidence[14] and worked later with H. F. York on the cyclotron.[15] Additional papers resulted from his work with graduate students R. Phillips, Vincent Peterson, and E. A. Martinelli on the 184" cyclotron on neutral and charged mesons, with Vincent Peterson on pi production by protons, and with Sue-Gray Al-Salam on meson-induced fission.[16] He also did a precision experiment on electromagnetic shower propagation and on proton-proton scattering at 32 MeV, using the Alvarez accelerator. His accomplishments as an experimental physicist led to job offers from Columbia, Princeton and Harvard. Berkeley, however, provided the opportunity to combine particle physics with engineering design and instrumentation.[17]

Despite the scientific excitement, the campus climate changed dramatically in 1951. The University of California became embroiled in a faculty-administration confrontation when the state's conservative legislature and Board of Regents insisted that an oath of loyalty be required of all university staff. The issue soon moved from one of loyalty to the United States to the obligation of faculty to obey the Regents. Many faculty protested on the basis of non-

---

[10] Alvarez to Birge, quoted in Raymond T. Birge, History of the Physics Department, vol. V., Chapter XVIII, (Berkeley: University of California, 197ff) 30; Panofsky and Phillips, Classical Electricity and Magnetism (Addison-Wesley, 1955; 2nd ed. 1962).

[11] "W.K.H. Panofsky: Transcript," 73.

[12] Ibid. 74, 75, 89.

[13] Drell, "Pief Fest," p.4; L. Aamodt, J. Hadley, W.K.H. Panofsky and R. Phillips, "The Gamma-Ray Spectrum Resulting from Capture of Negative Pi-Mesons in Hydrogen," Physical Review 80 (1950) 94; Aamodt, Hadley and Panofsky, "The Gamma-Ray Spectrum from the Absorption of Pi-Mesons in Deuterium," Physical Review 80 (1950) 282; Aamodt, Hadley, and Panofsky, "The Gamma Ray spectrum Resulting from Capture of Negative Pi-Mesons in Hydrogen and Deuterium," Physical Review 81 (1951) 565.

[14] Drell, "Pief Fest, p.4; W.K.H. Panofsky, J. Steinberger and J. Steller, "Evidence for the Production of Neutral Mesons by Photons," Physical Review 78 (1950) 802; Panofsky, Steinberger and Steller, "Further Results on the Production of Neutral Mesons by Photons," Physical Review 86 (1952) 180.

[15] W.K.H. Panofsky and H. F. York, "Absorption of Pi- Mesons in Hydrogenous Materials," Physical Rev 78 (1950) 89; Aamodt, Panofsky, and York, "The Gamma-Ray Spectrum from the Absorption of Pi- Mesons in Hydrogen," Physical Review 78 (1950) 825.

[16] E. A. Martinelli and W K.H. Panofsky, "Magnetic Deflector for Mesons Produced in the 184-inch Cyclotron," Review of Scientific Instrumentation 20 (1949) 4; Panofsky and Martinelli, "The Lifetime of the Positive Pi-Meson," Physical Review 77 (1950) 465.

[17] "W.K.H. Panofsky: Transcript," 107.

consultation rather than substance but some also objected to the requirement's explicit intolerance. Having endured the intrusive red-tape required for war-time naturalization and security clearances, Panofsky joined other Radiation Laboratory scientists in signing the oath. "The Rad Lab by and large was not what you might call the hotbed of protest," Panofsky later noted. He well understood, however, the objections of other faculty, particularly those who had experienced European fascism. He insisted that rights of non-signers be respected and viewed dismissal of non-signers as a violation "of all that is true about academic freedom and tradition in the European sense." Although reluctant to leave Berkeley, he decided he must resign on principle. "People such as I, who had been born in Europe, were more sensitive to a loyalty oath requirement because such an oath had been used as a tool by European dictators." If the moral objections of these professors were not to be respected, Panofsky felt he could not stay.[18]

Panofsky's decision to move across the bay to Stanford University rather than to take up an offer from Columbia or Princeton no doubt surprised many. Alvarez tried to dissuade him, convinced that little or no decent physics could be done with Stanford's electron linear accelerator and that the move to Stanford would blight Panofsky's future in physics. Panofsky, in fact, knew little about the Stanford physics program, only that the Mark III electron accelerator program on campus was beginning to work, and that several noted Stanford physicists had an interest in nuclear physics but were not inclined to become too closely involved in accelerator development. But Stanford offered a number of clear advantages: "Firstly, we loved California." He, Adele, and their four children, did not want to leave the West Coast. "Secondly, I really didn't want to go...so I didn't have to go very far, and in fact, one could sort of go gradually." Equally important, he liked the people at Stanford and they liked him.[19] Unlike the other offers, Stanford presented a challenge aimed specifically at Panofsky as a physicist who knew the technical, scientific *and* organizational needs of an ambitious but faltering program. He decided "what the devil, physics is physics, and one can essentially do it anywhere." But, he later admitted, "I certainly had no confidence either that much physics could be done here."[20]

"The Tribe Across The Bay": Stanford University

When Panofsky arrived at Stanford, he faced a heavy teaching schedule and what turned out to be a "fairly sick" accelerator. Physics Department tradition, strongly supported by the department's senior members, expected faculty to teach four to five quarters of lower division and graduate courses a year along with relevant lab sections. Panofsky's courses were very popular among undergraduates and graduates alike, known for clear and engaging lectures as well as demanding requirements.

As he plunged into life at Stanford, his attention soon turned to the struggling Mark III program. Stanford's first linear accelerators were built under the direction of the highly respected physicist William W. Hansen and were intended to serve as research tools for Stanford's physicists. Following Hansen's untimely death in 1949, the Mark III was completed under the guidance of applied physicist Edward Ginzton, an expert in microwave technology. Mark III began limited operation in 1951 but, in order to attain the projected energy of 1 GeV, the accelerator was extended to a longer length than was originally intended. Once this extension was completed in 1952, the accelerator itself reached some six inches short of the wall of the building with no room remaining for the installation of experimental apparatus. Meanwhile, Ginzton had shifted from accelerator development to work on military contracts for microwave tube development and Bob Kyhl, microwave specialist in charge of the machine, was bogged down with difficult klystron performance and vacuum problems. Professor Robert Hofstadter, the only faculty member then conducting research with the Mark III (at its half-way point), was determined not to get sidetracked with accelerator development. Panofsky sized up the situation and designed a solution in the form of an end station for experimental work that was linked to the end of the accelerator by a "beam switchyard" which would transmit beams at a selected energy into the end station.

---

[18] Donald Stokes, "'Pief' Panofsky tells his High-Energy Story," [Stanford University] Campus Report (8 February 1984) 6; "W.K.H. Panofsky: Transcript," 128.

[19] Panofsky was visited by Stanford's Leonard Schiff, chairman of the Physics Department, and theorist Felix Bloch, who had already concluded "He is really exceptionally good and wise." Bloch to Schiff, Sept. 2 [1950] Leonard Schiff Papers, box 17/3, SC 220, Special Collections Dept., Stanford University Libraries (quoted in Peter Galison, Bruce Hevly and Rebecca Lowen, "Controlling the Monster: Stanford and the Growth of Physics Research, 1935-1962," Galison and Hevly, eds., Big Science: The Growth of Large Scale Research (Stanford: Stanford University Press, 1992) 63.

[20] "W.K.H. Panofsky: Transcript," 128.

By 1953, Panofsky and Ginzton had worked out an organizational solution: to revitalize and reorganize the research and development programs, they created the umbrella W. W. Hansen Laboratories of Physics, under which Ginzton, as director of the Microwave Laboratory, would share shops and administration with Panofsky's High Energy Physics Laboratory (HEPL). Ginzton's group concentrated on klystron development and Panofsky's took primary responsibility for particle physics research, with both groups coming together to collaborate on accelerator development. By the end of 1953, the Mark III was 220 feet long, producing 400 MeV, and serving as the source for a series of experiments. As the decade progressed, significant contributions were made at HEPL. In 1954, Stanford Medical School cancer specialist Henry Kaplan began his initial studies of electron therapy for cancer. Hofstadter's experiments to establish the electromagnetic dimensions of the proton and the neutron, and of heavier nuclei earned him a Nobel Prize in 1961. Meanwhile, additional landmark experiments were conducted in inelastic electron scattering and the electromagnetic behavior of muons and pions. Panofsky carried out a number of these experiments with graduate students. Among these were the first observations of muon-pairs produced by photons, the determination of the form-factor (i.e. the size) of the excited state of the proton, and measurement of the radiation length in hydrogen.

Project "M" And SLAC

By mid-decade, with Stanford's high energy physics program well underway, Hofstadter, Panofsky, Ginzton and a number of their colleagues saw the need for an even larger, fourth generation machine. Following on Hansen's prototypes, Panofsky and Ginzton took leading roles in the development of a plan to build a two mile accelerator -- 30 times larger than the Mark III -- on the Stanford Campus. "Project M" (for "the Monster") was born in April 1956 when a group of Stanford physicists gathered at Panofsky's home to discuss the possibilities and implications of a more powerful linear accelerator.[21] In addition to their campus responsibilities, Ginzton was named director of the Project with Panofsky as deputy director.

Difficulties proved to be social as well as technical on both the local and national levels. The first controversy arose as Panofsky and Ginzton asserted that to justify major federal funding, the project had to be designed as a national facility open to all scientists, without preference given to Stanford physicists.[22] While it was generally recognized that a machine of this magnitude could no longer be constructed with university funds and small national grants, some department faculty were concerned about the implications of open access to non-Stanford scientists: would they lose access for their own experiments? An added technical twist suggested the need for a strong, *in-house* team of high energy physicists. The high intensity and low duty cycle of the electron machine, in Panofsky's view, required a "facility-centered" experimental program rather than a "user-centered" one:

> *This group would have to put a large part of its scientific skills and careers "on the line" to design the equipment for exploiting the electron beam once it became a reality. The leaders of this research staff therefore had to be regular members of the Stanford University faculty, because attracting the necessary talent would only be possible if the leadership were composed of 'first-class citizens' on campus.*[23]

In a rare feat of academic tight-rope walking, Stanford convinced the Atomic Energy Commission (AEC) and the outside physics community that full and equitable access to the facility would be provided while simultaneously assuring the Stanford community "that the Monster was not a threat to regular academic values" and would not overwhelm existing university administrative machinery. To address the Physics Department's fear of an imbalance of high energy physicists (with few departmental responsibilities) to the disadvantage of Stanford physicists in other subfields, an uneasy compromise was created: the program as a whole was designed to operate under general university policy, with the participation of its in-house faculty in university affairs, but its operation would be autonomous and in accordance with Stanford University's contract with the AEC (now the Department of Energy.)[24]

---

[21]Hansen articulated the need for a "truly large accelerator" as early as 1947 and Hofstadter suggested the need for a machine at least 10 times larger than the Mark III in 1954. Departmental discussions began in 1955, and a formal feasibility study was undertaken in 1956.

[22]W.K.H. Panofsky, "The Evolution of SLAC and Its Program," Physics Today (October 1983) 35.

[23]Ibid.

[24]The implications of the project and the divisions it caused among Stanford's physics department faculty are particularly well described in Galison, Hevly and Lowen, "Controlling the Monster: Stanford and the Growth of Physics Research, 1935-1962," Op.cit., 46-99.

A different kind of battle was waged with the U.S. government over what Panofsky, backed by Stanford's president J. E. Wallace Sterling and the Stanford Board of Trustees, deemed a principle of academic values. While traditional AEC contracts included a stipulation that the Government could impose security requirements on an open-ended basis, Panofsky was not interested in promoting classified research at the facility. He rejected outright the imposition of security regulations as a contractual obligation. With five years' work and a $114 million contract on the table, he went against the advice of much of the physics community and he opposed security restrictions. The AEC backed down, and an idiosyncratic contract regarding open access to facilities and the results of SLAC research was signed by the University and the AEC. Similarly, Stanford was granted responsibility for all facets of contributions to the new laboratory.

In 1961, after Ginzton had stepped down as project director to assume leadership of the microwave development company Varian Associates, Panofsky took over as director of the newly named Stanford Linear Accelerator Center (SLAC). Following several rounds of congressional hearings in which the major objections were political rather than scientific, the Stanford project was authorized by the U.S. Congress in 1961. When the Project was initiated, Panofsky later noted, "we were fully aware of the fact that the SLAC machine was a maverick in the then-prevalent pattern of US high-energy physics." In short, few American physicists were interested in electron machines. However, since the annual federal budget for science was growing rapidly and competition was minimal,[25] the physics community for the most part, acquiesced on the assumption that the Stanford "linac" would provide little threat to the major proton projects underway.

The story of SLAC's construction is well documented in SLAC's "Blue Book."[26] Between groundbreaking in July 1962 and acceleration of the first full-energy beam over the entire two mile length of the linac in 1966, Panofsky created not only a physical setting but a community of physicists, engineers, technicians, and support staff.[27] As director in this, as in previous projects, Panofsky was known for his accessibility and creative conflict resolution. "His patience and energy never seem exhausted; he has led with candor, with an innate ability to resolve conflicts constructively and by being creatively involved in every aspect of the Lab's activities," commented his colleague and deputy director, Sidney Drell. "He has created an organization whose spirit and lively intellectual atmosphere have nurtured individual creativity. Indeed, the style and spirit of SLAC are truly a reflection of his own personality."[28]

Over the next 23 years, Panofsky supervised the design and construction of SLAC and the development of its physics program and its operation. He oversaw its research programs for both fixed target and colliding beam experiments and directed efforts for development of SPEAR (initially called the Stanford Positron Electron Asymmetric Ring, later Stanford Positron-Electron Accelerating Ring); of the Positron-Electron Project (PEP); and of initial work on the Stanford Linear Collider (SLC). While SLAC physicists and engineers extended the boundaries of high-energy physics, they also manufactured much of the often-complicated machinery needed for the new techniques. Panofsky sought a strong, in-house team of physicists, engineers, and technicians. As a result, SLAC developed machine shops and assembly facilities, sophisticated instruments, and a highly respected engineering staff. Panofsky noted: "The wisdom of having a full capability across a full spectrum of technology has been shown repeatedly. Had we not been able to complete projects when industry could not, we would have had major setbacks."[29]

Counter to the pessimists of the early 1960's, SLAC was at the center of new discoveries in high energy physics, placing a new importance on electron physics. Early experiments at SLAC on inelastic electron scattering were the first to point to the substructure within the proton -- the "seeds" that eventually came to be identified as the basic quark building blocks of matter. The work done at the SPEAR storage ring during the 1970's included the discovery of the J/psi particle

---

[25]"University of Hamburg honors Panofsky," News Release, Stanford University, September 21, 1984. Stanford News Service; Panofsky, "The Evolution of SLAC," 35.

[26]R. B. Neal, ed., <u>The Stanford Two-Mile Accelerator</u> (New York: Benjamin, 1968). An excellent summary is provided in Panofsky, "The Evolution of SLAC and Its Program," (Oct. 1983) 34-41

[27]When the beam failed to reach its design intensity, the unforeseen result of the "beam break-up" phenomenon, Panofsky analyzed the physics of that process and remedies were designed accordingly.

[28]Drell, "Pief Fest," 8.

[29]Stokes, 'Pief' Panofsky Tells His High-Energy Story," 6.

-- leading to the confirmation of the fourth kind of quark ("charm") -- and the discovery of the third kind of charged lepton (the tau), believed to be two of the fundamental building blocks of matter. SLAC has been instrumental in providing the experimental evidence for the present paradigm in its field: the "Standard Model" of leptons and quarks and the forces that act among them.[30]

By the time Panofsky retired as director in 1984, he could log two Nobel Prize earned "on his watch," along with numerous other prizes for research undertaken at SLAC.[31] "The SLAC facility," he noted with pride in his resignation letter, "is recognized as second to none in experimental physics, particle theory and collider technology." That year, he passed leadership of the Center, with some 1200 employees and an annual budget of $80 million excluding construction, to 1976 Physics Nobel Laureate and SLAC faculty member Burton Richter.

Science and Society

Panofsky's interest in arms control and the social implications of scientific development first surfaced as a concern for public education. As a young Berkeley professor, he gave public talks to a wide range of groups (from the League of Women Voters to the San Francisco Plumbers Union) about the significance of atomic weapons and the changing nature of warfare. "In retrospect," he later commented "it was a very naïve approach to this very complex problem...I gave them factual information, what it was all about, about the history of the Manhattan Project, about what made the difference between nuclear energy and other forms of energy." Beyond the facts, however, his motivation was "to get public sentiment for some kind of control on an international scale."[32]

His understanding of the complex nature of international affairs and human relations evolved over the next three decades as he served as advisor to many government agencies and administrations, including the President's Science Advisory Committee (PSAC) under Presidents Eisenhower and Kennedy, and as a member of the General Advisory Committee (GAC) on Arms Control under President Carter. As chairman of the 1959 State Department "Technical Working Group on High Altitude Detection of Nuclear Explosives," he played a prominent role in negotiations with the Soviets that later resulted in the signing of an atmospheric test ban treaty during the Kennedy administration. As a high energy physicist and arms control expert, Panofsky also was called on as a consultant to the Atomic Energy Commission, the US Air Force, and the National Science Foundation. In 1970, his ongoing interest in arms control brought him together with other Stanford professors to found the University's Center for International Security and Arms Control.[33]

Panofsky was a member of the National Academy of Sciences and the American Academy of Arts and Sciences. A fellow of the American Physical Society, he served as its Vice President in 1973 and took office as President in 1974. From 1967 to 1970 he was a member of the High Energy Physics Advisory Panel (HEPAP). A member of the Board of Overseers of the Universities Research Association for the Superconducting Super Collider Laboratory (SSC) in Texas from 1984, Panofsky served as its Chairman from 1985 to 1993. In 1985, he was appointed Chairman of the Committee on International Security and Arms Control of the National Academy of Sciences (CISAC), a committee on which he had served since 1981. Panofsky chaired the CISAC Workshop of the German-American Academic Council (1994-1995) and a committee of the U.S. DOE Office of Nonproliferation and National Security (1996-1997), in addition to serving as a member of several other committees concerning arms control throughout the 1990s and through 2001. He also enjoyed the dubious honor of being one of only two physicists to be profiled by Playboy Magazine.[34]

---

[30] For more information on SLAC's experimental program, see "Series Description: Series IV, SLAC."

[31] SLAC's Burton Richter shared a Nobel Prize with Brookhaven's Samuel Ting in 1974 for the simultaneous discovery of the J/psi particle; in 1990 Richard Taylor was awarded a Nobel prize with Henry Kendall and Jerome Friedman of MIT for their early experiments at End Station A that revealed the proton and neutron to be composed of smaller, more fundamental objects called quarks. In 1982, Martin Perl was awarded the Wolf Prize for the discovery of the tau at SLAC's SPEAR machine.

[32] "W.K.H. Panofsky: Transcript," 113.

[33] Throughout the 1970's and much of the 1980's, only a handful of colleges and universities offered courses in arms control, that is: Stanford, MIT, Harvard, Cornell and UCLA.

[34] Playboy Magazine, June 1977; Playboy noted that among his contributions was a straight 10,000-foot long vacuum pipe "that is housed in a heavy concrete casing sunk 25 feet underground that has no practical use whatsoever."

The various awards and citations Panofsky received reveal something of the breadth of his accomplishments as well as the deep respect he earned from diverse communities. He received the U.S. Atomic Energy Commission's E. O. Lawrence Award in 1961 (for his fundamental contributions to meson physics and on detection of nuclear explosions in space); the Franklin Medal from the Franklin Institute in 1970 ("particularly for accelerator design, construction and successful exploitation"); the Leo Szilard Award of the American Physical Society in 1982 (for his contributions to society through his arms control work); Harvard's Loeb Lecturer; the Richtmeyer Lecturer by the American Association of Physics Teachers; California Scientist of the Year by the California Academy of Sciences in 1967; the National Medal of Science in 1969; the Enrico Fermi Award in 1979 (for his contributions to elementary physics and accelerator physics, for his inspiration to younger scientists, and "for the depth and thoughtfulness of advice he has so generously given the United States Government"); the inaugural Hilliard Roderick Prize in 1991 for Excellence in Science, Arms Control, and International Security; and the Matteuci Medal in 1996. After serving as a trustee from 1969-1995, Panofsky received a Lifetime Achievement Award from the San Francisco Exploratorium in 2003. Perhaps the most eloquent citation is the following, from the text of Panofsky's 1983 honorary doctorate from his alma mater, Princeton University:

> *He has led our quest for the ultimate constituents of inanimate nature, using the resources of modern technology to open the realm of high-energy elementary particle physics and to catch glimpses of a fleeting world of 'color,' 'charm', and 'strangeness.' Knowing intimately the awesome power of the atom, he has counseled us in the arena of nuclear arms, soberly reminding us of the mutually assured destruction that is the most likely outcome of their use.*

International recognition has also pointed to Panofsky's contributions both to science and international relations. Elected a member of L'Academie des Sciences (France), an "officier" of the French Legion d'Honor (1977), and fellow of Accademia Nazionale dei Lincei (Italy), he received numerous honorary degrees.[35] Three years after receiving an honorary doctorate from the University of Hamburg (1984) for his work in high energy electron physics, Panofsky was awarded an honorary professorship from Beijing University for both his scientific accomplishments and his work for world peace.[36] In 1989, he was elected one of only two Americans selected as foreign members of the USSR Academy of Sciences (now the Russian Academy of Sciences) for his scientific accomplishments in nuclear physics and, as Academy President G. I. Marchuk stated, on the hope that he could "further strengthen the relations between USSR and USA scientists." In 2002, Panofsky was elected Foreign Member of the Chinese Academy of Sciences.

Panofsky received many accolades for his contributions to science and public policy but closer to home he was a noted Stanford community citizen and leader. He played a key role in the formation of the Stanford Mid-Peninsula Urban Coalition and the Stanford Mid-Peninsula Citizens for Fair Housing, and was a co-founder of the Martin Luther King, Jr. Memorial Fund at Stanford shortly after Dr. King's death. Considered a sage as well as industrious member of the Stanford academic community, he served on a wide variety of University committees, including the Academic Council's Advisory Board and its Committee on the Graduate Division, and the University's Committee on Minority Affairs. As Laboratory professor emeritus and director emeritus, his open door policy, his fairness and sensitivity, his wit and honesty, and his personal commitment to human rights and affirmative action were widely appreciated.

In 1985 the American Physical Society Division of Particles and Fields, Stanford University, and friends of Panofsky established the annual W.K.H. Panofsky Prize in Experimental Particle Physics “to recognize and encourage outstanding achievements in experimental particle physics.”[37] Four years later, in 1989, SLAC established the “Panofsky Fellowship” in his honor, with the intent “to recognize exceptional and promising young scientists who would most benefit from the unique opportunity to conduct their research at SLAC National Accelerator Laboratory.”[38]

---

[35] In addition to honorary degrees from Case Western (1963), Columbia (1977, Princeton (1983), and Yale (1985), Panofsky was similarly honored by the University of Saskatchewan (1964), University of Hamburg (1984), University of Beijing (1987), University of Rome (1988) and University of Uppsala (1991).

[36] Panofsky also helped the Chinese build an electron-positron collider, a device similar to SPEAR, but of higher luminosity.

[37] Retrieved from https://www.aps.org/programs/honors/prizes/panofsky.cfm , 9/21/2018

[38] Retrieved from https://sites.slac.stanford.edu/cro/panofsky-fellowship, 9/21/2018

A month after his September 24, 2007 death at his home in Los Altos Hills, California, Springer published Panofsky's memoir, Panofsky on Physics, Politics and Peace, an account he described as, not an autobiography, but a "recital of memorable episodes" from his life's work in physics and arms control.[39] He is survived by his wife Adele, their five children, 11 grandchildren, and 3 great-grandchildren.[40]

Scope and Content

The bulk of the Panofsky collection consists of files regarding Dr. Panofsky's responsibilities as professor of physics, laboratory director, and advisor to government and academia on high energy physics, accelerator development, and arms control. A major portion of the collection consists of extensive administrative and professional correspondence and memoranda, subject files, minutes and reports, and other materials relating to the development and evolution of the Stanford Linear Accelerator Center. Official laboratory records also include experiment proposals, contracts, budgets, and personnel materials. Among the records of the Director's Office is material regarding relations with other high energy physics laboratories and the development of accelerators world-wide.

In addition to materials regarding arms control, the collection includes files regarding Panofsky's activities as President of the American Physical Society, chairman of the Board of Overseers of the Superconducting Super Collider, and member of the President's Science Advisory Committee (PSAC) and of the High Energy Physics Advisory Panel (HEPAP) of the U.S. Department of Energy.

Also included in the collection are research materials from Panofsky's years as a student (1935-1942), research physicist (1942-1946) and physics professor (1946-1989, emeritus) in his specialty fields of X-rays and natural constants, accelerator design, nuclear research, and high energy particle physics.

Arrangement

The collection is arranged in ten series reflecting Panofsky's career: his student years and early career as a research physicist at the Radiation Laboratory at U.C. Berkeley and as professor of physics at Berkeley and Stanford, his work as founding director of the Stanford Linear Accelerator Center, as well as his roles as science policy and arms control advisor and President of the American Physical Society. Later series include his other professional activities and correspondence, as well as extensive correspondence and personal documentation, including photographs. Additional imagery, artifacts, and oversized materials can be found at the end of the collection.

SERIES I: EDUCATION AND EARLY CAREER, 1934-1951

Panofsky attended Princeton University (1935-1938) and the California Institute of Technology (1938-1942), receiving his Ph.D. in Physics from Caltech in 1942. This series includes examinations, lecture notes, lab instructions, and miscellaneous problem sets from his undergraduate years, as well as his senior thesis, "The Construction of a High Pressure Ionization Chamber" (1938). Similar materials are present from his graduate studies at Caltech including notes from J. R. Oppenheimer's course on nuclear physics. His 1941 dissertation, "A Measurement of the Value of h/e by the Determination of the Short Wavelength Limit of the Continuous X-ray Spectrum at 20 kV," can also be found here. Panofsky's work on an acoustic firing error indicator while at Caltech is also included in this series.

In 1945, Panofsky joined the Radiation Laboratory at the University of California, Berkeley as a staff physicist and in 1946 was appointed to the University's physics faculty. This subseries includes lecture and research notes from this period, course outlines and notes, and miscellaneous problems used in his teaching of undergraduate physics. It also includes Panofsky's work on the Bevatron and on the MTA Project.

---

[39] Panofsky on Physics, Politics and Peace, Springer 2007. Preface p.v

[40] Drell, Sidney D and Trilling, George H. (2010) "Wolfgang Kurt Hermann Panofsky, 1919-2007." National Academy of Sciences

Articles and reviews written by Panofsky during this time can be found in Series VII. Correspondence with Melba Phillips regarding their jointly-authored text on <u>Classical Electricity and Magnetism</u> and other subjects, including notes from their joint work on p-d reaction in carbon, is also included in Series VII.

- I A: Princeton University Years, 1934-1938
- I B: California Institute of Technology Years, 1938-1947 bulk (1938-1962 inclusive)
- I C: University of California, Berkeley Years, 1945-1951 bulk (1935-1977 inclusive)

SERIES II: STANFORD UNIVERSITY, 1951-1984 bulk (1949-2007 inclusive)

In 1951, Panofsky crossed the Bay to join the Stanford University faculty as Professor of Physics. Although much of his time was taken up with teaching and his work at the High Energy Physics Lab, he also served on the search committee for a new Chemistry Department Chair (1958) and another for a new Vice President for Public Affairs (1983) and took an active interest in the new Physics Building lecture hall (1956-58). In fact, he served on numerous University committees including the Advisory Board of the Academic Council (1972-73), and the Council's Committee on the Graduate Division (1966-1969); the University Committee on Minority Affairs (chair) (1970-71); the Presidential Advisory Panel on the Review of Health and Safety Issues (1988); and the Civil Defense Fall-Out Shelter Committee. Files regarding these committees are included in this series. Panofsky was a member of the Advisory Board when it reviewed the dismissal case of Professor H. Bruce Franklin during 1971-72, and he served as the Hearing Officer in the Henry Organ Grievance Case. The collection includes official documentation from the Franklin case as well as documents and correspondence following the Academic Council decision (1971-1980). All or part of the material from these two cases is confidential and access is subject to review by Stanford University. When, in 1962, Panofsky resigned from the Physics Department to become a member of the physics faculty "at SLAC", he retained full university faculty status and continued to teach physics and supervise graduate theses.

This series contains numerous files of his physics teaching lecture notes and problems, 1955-1959, and lecture notes for Physics 51 by professors Robert Hofstadter and Leonard Schiff. Also included are his physics research papers and notes from 1951 until he became director of SLAC (1961), a proposal with Gerry O'Neill, Burt Richter and Carl Barber for an experiment requiring the construction and use of the Princeton-Stanford (electron-electron) collider, as well as a number of files of manuscripts and papers of colleagues (including John Blewett, Emilio Segré, and K.M. Crowe).

In addition to teaching physics, Panofsky developed courses in arms control and disarmament, first through the Stanford Workshop On Political and Social Issues (SWOPSI) Program and later through the Center for International Security and Arms Control, later renamed the Center for International Security and Cooperation (CISAC). Course materials from his classes (1969-1988) are filed in this series. CISAC-related materials dated well beyond his official role as Stanford faculty are filed here due to his continued interest and involvement as well as to his capacity as professor and director emeritus.

In 1953, Panofsky was named director of the High Energy Physics Laboratory (HEPL). Papers regarding his directorship and the operation and development of the laboratory were retained at HEPL and much of this material is preserved by the Stanford University Archives.

Additional information about Stanford University affairs and records of departments and committees can be found in the Stanford University Archives. The University Archives also preserves the papers of Physics Department colleagues Leonard Schiff, Felix Bloch, William Hansen, and Russell and Sigurd Varian.

- II A: University Committees: Academic Senate, 1966-1976 bulk (1966-2003 inclusive)
- II B: Stanford Miscellaneous (committees other than Academic Council), 1956-1989 bulk (1952-2004 inclusive)
- II C: Confidential material, 1966-1980 bulk (1958-1980 inclusive)
- II D: Arms Control Class / Center for International Security And Cooperation, 1969-2007
- II E: HEPL Research Papers and Notes, 1951-1961 bulk (1949-1961 inclusive)
- II F: Physics Department Courses and Students, 1951-1961 bulk (1950-1993 inclusive)
- II G: Publications and Research Documentation (includes CERN Technical Memos), 1951-1965 bulk

(1951-1982 inclusive)
II H: Manuscripts by Others, 1951-1987 bulk (1941-2001 inclusive)

SERIES III: PROJECT "M," 1954-1969

Project M, probably named for "multi-BeV" and "monster",[41] grew out of the interest of Stanford physicists in developing a longer, more powerful linear electron accelerator than the 1 BeV Mark III with which they had enjoyed so much success at HEPL. A formal feasibility study was undertaken in 1956 by faculty and staff associated with the Hansen Microwave Laboratories. A proposal for a two-mile long electron linear accelerator to be built on the Stanford campus was submitted by the University in 1957 to the Office of the Secretary of Defense for Research and Engineering, the Atomic Energy Commission and the National Science Foundation.[42] The "Project" continued until 1962 when Stanford and Congress signed the official contract for construction of the Stanford Linear Accelerator Center (the name of the project was officially changed from "M" to SLAC in December 1961[43]). Geological investigations as well as reports by the Architect-Engineer-Manager team of Aetron-Blume-Atkinson are included.

Files regarding Project M from other sources are in process in the SLAC Archives, though the correspondence maintained by Project business director Fred Pindar has been interfiled with that of Panofsky in order to create a more complete record. Although this results in some duplication, there is a great deal of unique material. A chronological arrangement was chosen to aid the researcher. Also included are the published proceedings from the hearings of the Joint Committee on Atomic Energy (JCAE), July-August 1959 and April 1960, and published and unpublished informational materials produced about the Project at this time. The final subseries, "Accelerator Design Division," contains material from the first stages of construction and serves as a transition to Series IV.

The papers of Project colleague Edward Ginzton are available in the Stanford University Archives. Also of interest are relevant files in the records of Stanford President J. E. Wallace Sterling and in the records of University Provost Frederick E. Terman, also located in the University Archives.

III A: Administrative Files, 1954-1961
III B: Director's Office, 1960-1967
III C: Project M Reports, 1954-1962
III D: Congressional Record and JCAE Hearings, 1958-1962
III E: Aetron-Blume-Atkinson, 1959-1969
III F: Accelerator Design Division (Transition), 1961-1963

SERIES IV: STANFORD LINEAR ACCELERATOR CENTER, 1961-1984 bulk (1950-2007 inclusive)

The Stanford Linear Accelerator Center, now SLAC National Accelerator Laboratory, located on 426 acres of Stanford University land to the west of the main campus, is a national facility operated by Stanford for the U.S. Department of Energy. At the onset, SLAC was devoted to experimental and theoretical research in elementary particle physics and to the development of new techniques in high-energy accelerators. The Center was originally one of a handful of laboratories worldwide that investigated subnuclear particles and the forces that act between them. It has since expanded its scientific portfolio to encompass research in and using accelerators, detectors, x-rays and lasers. When Panofsky retired from his position as director of the laboratory in 1984, the Center had a staff of about 1200, with 150 staff physicists engaged in particle physics research with some 300 physicists from some 100 institutions worldwide involved in carrying out experiments at the site.

---

[41] "W.K.H. Panofsky: Transcript of an Interview taken on a Tape Recorder by Charles Weiner on 3 June 1974," Center For History of Physics, American Institute of Physics (New York, 1973), 20.

[42] Dupen. D.W. "History and Development" Chapter 3 of Neal, R.B., ed. The Stanford Two-Mile Accelerator. According to Kirk, History of SLAC, proposal was written by W. Kirk and Karl Brown, and was, at the time, the most expensive scientific project ever proposed

[43] *SLAC BeamLine* February, 1975 p. SS-10; Bob Moulton Papers, AHRO accession 1991-012, Box3, Folder 115, "Project Name."

The records in this series broadly document the construction, evolution and operation of the Stanford Linear Accelerator Center from the perspective of the Laboratory's director and senior physicists. From 1962 to his retirement in 1984, Panofsky supervised the construction and operation of SLAC and its facilities as well as the development of its research program. He oversaw the research programs for both fixed target and colliding beam experiments and directed efforts for the development of SPEAR, PEP and SLC (described below). Included are extensive administrative correspondence and memoranda of the Director; experiment proposals; contracts; budgets, and personnel materials; accelerator and detector design; plant engineering and other technical matters; and the physics research program. Additional files also document Panofsky's ongoing work on the development of other accelerator facilities both in the United States and internationally. (Later DOE-related material, as well as overlapping material on IHEP and BEPC work in China, are filed with Science Policy and Administration in Series V.)

Panofsky was named director of the Lab in 1961, and work soon began on both design and construction plans and the development of a research program. A series of summer study groups (1960-63) encouraged academic interest in electron physics and developed potential experiments for research at SLAC. Experimental research began in 1966 with the completion of the two mile linear electron accelerator, a machine capable of producing an electron beam with an energy up to 20 BeV. The initial research program, 1966-1972, focused on fixed target experiments consisting of high energy electron beams directed at nuclear and subnuclear targets in the "end stations." These early SLAC experiments were the first to show that the elementary particles which comprise the atomic nucleus, the proton and the neutron, are themselves composed of smaller, more fundamental objects called quarks.[44] High precision experimentation demonstrated that two of the four forces of Nature, the electromagnetic force and the weak force, were different manifestations of what is one, single force at the super energies extant at the beginning of the universe.[45]

As originally designed, the two-mile long machine accelerated electrons into stationary targets. Inside the target material, the electrons scattered from the nucleus. This collision caused other particles to be formed, and, from the nature of these products, one can divine the nature of the nuclear matter. However, because one particle comes flying at another which is stationary, there is an overall momentum in the system; the momentum must be conserved. Thus, the energy which is available from the initial collision must contribute to the momentum in the resulting system. So, in essence, energy is "wasted" in moving the particles which are created or those which remain from the collision. It was long recognized that, if one could move the two elements in such a way that they would contain equal but opposite momenta, then there would be no net momentum, and all of the energy could be available for new particle formation. Furthermore, if the two accelerated bits of matter consisted of a particle and its corresponding anti-particle, then the particles would annihilate each other upon collision; their mass energy as well as their energy of motion would be available for new particle production. In order to achieve new particle production in this way, physicists began looking for a feasible technique for utilizing colliding beams.

The first proposal for an electron-positron (the electron and its anti-particle) storage ring at SLAC was submitted in 1964 by professors Burton Richter, John Rees, and David Ritson. After five years of unsuccessful fund- raising for machines costing between 9 and 18 million dollars, SLAC gained support from AEC controller John Abadessa to construct the 8 GeV Stanford-Positron Electron Asymmetric Ring (SPEAR), a ring 80 meters in diameter, for 5 million dollars using internal SLAC funds which had already been budgeted. Construction was completed in 18 months. Separate beams of positrons and electrons are produced by an accelerator, injected into a ring, and stored moving in opposite directions.[46] The counter-rotating beams are then directed to cross each other's paths. Online by 1972, SPEAR was soon producing significant results. Early research resulted in the discovery of an elementary subnuclear particle called the psi (made up of a combination of a quark and an antiquark of an entirely new kind.) Simultaneously discovered by Samuel Ting at Brookhaven National Laboratory (BNL) and named the J particle, the particle is often referred to as the J/psi. This new, fourth type of quark (called charm) served as convincing evidence

---

[44]The significance of this work was acknowledged in 1990 when the Nobel Prize in Physics was awarded to Jerome Friedman and Henry Kendall of MIT and Richard Taylor of SLAC.

[45]Charles Prescott was spokesman for the experimental team which performed this research.

[46]Originally the two-mile accelerator was used as the injector although, in 1990, SPEAR was provided with its own separate injector.

of that the basic idea of the quark structure of matter is valid.[47] A second revolutionary discovery made at SPEAR was that of the tau lepton which turned out to be the third in this family of charged particles.[48]

SPEAR also produced intense beams of synchrotron radiation (x-ray photons emitted by the circulating electron beams) that found extensive use for applied research in such fields as materials science and medicine. In 1973 SPEAR began to be utilized in experiments as a source for this radiation. By 1990, the SPEAR facility was dedicated to full-time synchrotron radiation research carried out by the Stanford Synchrotron Radiation Laboratory.

The success of SPEAR led to the construction of a much larger (800 meters in diameter) storage ring. In 1977, the Lawrence Berkeley Laboratory collaborated with SLAC to construct a new storage ring, the 30 GeV Positron-Electron Project (PEP), which operated most productively from 1980 to 1986. The PEP physics program contributed to the measurement of the lifetimes of certain elementary particles, the study of how the quarks that are initially produced in the collision then fragment or evolve into the various kinds of particles that are actually observed in the detection apparatus, and tests of Quantum Chromodynamics or QCD, the theory that is presently believed to describe the strong force which binds quarks together.

A storage ring capable of recirculating beams from the linac at full energy would have to be 17 miles in circumference. To provide the capability of producing colliding beams at full linac energies with Stanford's geography in mind, a new concept was developed--the Stanford Linear Collider (SLC). In 1983, construction began on the SLC, in which very high energy beams from the linac were brought around in arcs and aimed directly at each other, much as if the beams of two directly opposing linacs were aimed at each other. Completed in 1989, this frontier device was a novel kind of machine that served both as a test bed for a new accelerator technique and as a facility to reach the energy region where the recently discovered Z particle could be produced in quantity and in a simple environment. The key elements of the SLC were an extensive klystron upgrade to the existing two-mile linear accelerator to produce 50 GeV beams of both electrons and positrons, two small storage rings that were used to damp the beams down to suitable dimensions, two long curving arcs of magnets that were used to transport the separate electron and positron beams to a single collision point, an elaborate focusing system that reduced the cross-sections of the beams to dimensions smaller than that of a human hair, and a system for creating positrons and transporting them back for injection into the two-mile linac.[49]

A major reason for designing and constructing the SLC was to test the concept of a linear collider as a more economical way to accelerate electrons and positrons -- in a straight line rather than in a circular path. From the mid-1980's into the late 1990’s, much of SLAC's activity in advanced accelerator research and development was devoted to exploring this potential.

In 1984, Dr. Panofsky stepped down as director of SLAC, and was named Director Emeritus. Dr. Burton Richter was SLAC's second director. Additional and overlapping files can be found in the records of Dr. Richter in the SLAC Archives, History & Records Office (AHRO). In addition to records transferred to the SLAC AHRO from Research, Technical and Administrative offices, a number of oral histories of senior science and technical staff as well as laboratory publications are also available. Several files span years after Panofsky’s official retirement as director, since he remained engaged with SLAC affairs.

Talks, publications, and reports written in his capacity as Director of SLAC are included here, while those concerning Science Policy and other professional work are filed in Series V and Series VII, respectively.

IV A: Director's Office: Administrative Files, 1961-1984 bulk (1956-2007 inclusive)
IV B: Director's Office: Deputy Director Matt Sands, 1966-1969
IV C: Administrative, Personnel files, 1960-1998

---

[47] Burton Richter, leader of the research team, shared the 1976 Nobel Prize with Samuel C. C. Ting for the 1974 concurrent discovery of the J/Psi particle. SPEAR operation was at its height from 1972-1980. Today, it is one of the world’s most useful sources for synchrotron radiation. Originally the two-mile accelerator was used as the injector although, in 1990, SPEAR was provided with its own separate injector.

[48] Martin Perl of SLAC was awarded the Wolf Prize in Physics in 1982 for his discovery of the tau lepton.

[49] In April 1989, the first "Z" event was logged in at the SLC.

IV D: Business Division, 1960-1984
IV E: Director's Office: PEP, 1964-1983
IV F: Director's Office: Relations With Stanford Synchrotron Radiation Laboratory (SSRL), 1971-1993
IV G: Director's Office: Relations With Foreign/non-DOE Labs/Countries, 1962-1988 bulk (1950-2006 inclusive)
IV H: Director's Office: Relations With Other Governmental Agencies, 1961-1988 bulk (1956-1987 inclusive)
IV I: Research Division (Groups A, B, C, D, E, F), 1961-1982 bulk (1956-2004 inclusive)
IV J: Technical Division - Linacs 1960-1982 bulk (1960-1993 inclusive)
IV K: Technical Division - Beam Switchyard, 1961-1983
IV L: Technical Division - Accelerator Design, 1971-1984 bulk (1971-1998 inclusive)
IV M: Plant Engineering, 1961-1984 bulk (1961-2001 inclusive)
IV N: Director's Office: Talks, Publications And Reports, 1960-2000
IV O: Program Advisory Committee (PAC) Proposals, 1966-1984 bulk (1966-2007 inclusive)

SERIES V: SCIENCE POLICY AND ADMINISTRATION, 1950-2007

Throughout his career, Panofsky served as a member of many national organizations and as an advisor to many government agencies and administrations. This series brings together files regarding his participation in national and international science policy. Of particular significance are files relating to his work during the 1959 Geneva Test Ban talks with the Soviets; on the President's Science Advisory Committee (PSAC) under Presidents Eisenhower, Kennedy and Johnson; on the High Energy Physics Advisory Panel (HEPAP) of the Department of Energy; on a number of National Academy of Sciences committees, particularly the Committee on International Security and Arms Control (CISAC); and as member and chair of the Board of Overseers (BoO) of the Superconducting Super Collider (SSC). This series is arranged in alphabetical order by committee or organization, followed by subject files, including the U.S.S.R., China, Germany, Japan and Korea. The Amaldi Conference and DOE subseries were part of later accessions and serve as segues into Panofsky’s professional activities documented in the following series (VI and VII).

In 1959, Panofsky chaired the Technical Working Group on the Detection and Identification of High Altitude Nuclear Explosions at the Geneva Conference. This series includes transcripts of working group meetings, miscellaneous conference materials, and the final report of the working group.

The President's Science Advisory Committee (PSAC) was created by President Eisenhower to advise principally on defense matters but whose interest, as these records reveal, in fact ranged much more widely. Files in this series include discussion papers, reports, and other materials on such topics as pesticides, drugs and chemicals, research abroad, and the role of science and technology in the administration's "Poverty Program." PSAC was formally "scuttled" in 1973 by President Nixon after some members of the committee publicly disapproved of administration plans to move ahead with an antiballistic missile system (ABM) and a supersonic transport plane.[50] Included in this series are materials from the 1970 ABM Congressional hearings, correspondence concerning the subsequent attack by the ORSA (Operations Research Society of America) Ad Hoc Committee on Professional Standards, and additional correspondence (1971-1980) with the Office of Science and Technology. Also included are several files regarding the Strategic Arms Limitation Treaty (SALT).

The High Energy Physics Advisory Panel (HEPAP) files, which span the years 1954-2000, focus largely on accelerator research and development (including the SSC laboratory as well as other American and foreign laboratories), international high energy physics collaboration, and the future of high energy physics. Additional HEPAP files can be found in Series IV (SLAC) as they related specifically to the operation and support of the Stanford Linear Accelerator Center.

Elected to the National Academy of Sciences in 1954, Panofsky served on a number of NAS committees, some of which are represented in this series. Of special note are records relating to the Committee on International Security and Arms Control (CISAC). Panofsky joined the committee in 1981, serving as chair from 1985 to 1993. Files

---

[50] Wang, Zuoyue. <u>In Sputnik’s Shadow: The President’s Science Advisory Committee and Cold War America.</u> (Rutgers University Press, 2008). p. 291-292.

consist largely of meeting minutes and materials, publications and reports, regarding relations between the United States and the Soviet Union, and later between the United States and China and Japan. Many files originate from or are related to the National Research Council (NRC) which is the principal operating agency of the NAS and the NAE (National Academy of Engineering) to serve the government and other organizations.[51] Panofsky's work with CISAC comprises a substantial portion of this series and covers topics including: Nuclear Weapons Study, Warheads, Excess Weapons-Grade Material, Plutonium, Spent Fuel Standards, and Comprehensive Nuclear Test-Ban Treaty (CTBT) verification.

Panofsky was appointed to the Board of Overseers of the Superconducting Super Collider in 1984, although his interest in the SSC predates this (earlier files can be found among the HEPAP subseries). The SSC files in this series are composed almost exclusively of meeting materials, 1984-1990. Panofsky served as chairman of the Board from 1985-1993.

Also included in this series are files relating to the Energy Research Advisory Board (ERAB) and to JASON, an independent government advisory group of elite scientists whose activities are directed through The MITRE Corporation and supported by the Institute of Defense Analysis (and later, SRI International).

This series includes not only committee files but extensive subject files as maintained in Dr. Panofsky's office. These include publications, reports, and some correspondence regarding "Arms Control and Disarmament," (in several groups, dating from 1957 to 2007); "Civil Defense," (1958-2000); and "Nuclear Safety," which includes both reactor safety and nonproliferation issues (1963-2007).

Several sections of this series include materials regarding the special interest Dr. Panofsky had taken in the development of high energy physics in Europe, Russia and the Soviet Union, and the Peoples' Republic of China. Among these files are a range of trip reports to the Soviet Union of visiting American scientists; reports from conferences at Yerevan, Romaska, Kharkov and Dubna; and several reports on the status of high energy physics in the USSR. Several reports of trips to the USSR and China by Dr. Panofsky are also included. Materials filed in the subseries Germany relate to Panofsky's involvement with the German American Academic Council (GAAC), and include Peace Research Institute Frankfurt (PRIF) publications, general background files, and a paper from the 1965 Hamburg Conference on the production of nucleon isobars. A more complete record of European high energy physics can be found in Series IV in files relating to the DESY (Hamburg) and CERN (Geneva) laboratories. International collaboration on high energy physics receives additional coverage in correspondence and other files regarding the International Committee for Future Accelerators (ICFA), a working group created in 1976 by Commission 11 (C11) of the International Union of Pure and Applied Physics (IUPAP).[52] Dr. Panofsky was also involved with the Amaldi Conferences, a forum for international disarmament research.[53]

The Department of Energy (DOE) subseries covers topics such as declassification studies by the National Nuclear Security Administration (NNSA), scientific openness, export control, (NRC) committee oversight of the DOE nuclear weapons complex (with related material filed in the NAS subseries), and "inefficiencies." Also included are reports and reference material from the Nonproliferation and National Security Advisory Committee (NNAC), the Office of Research and Development (NN-20), and the TOPS (Technology Opportunities for Increasing the Proliferation Resistance of Global Civilian Nuclear Power Systems) task force,[54] followed by files regarding national laboratories (arranged in alphabetical order).

Dr. Panofsky was a founding member of the Center for International Security and Arms Control (now known as the Center for International Security and Cooperation, CISAC) at Stanford University. Records regarding the activities

---

[51] NRC stationery.

[52] Rubinstein, Roy, "What, Why, and Who is ICFA?" ICFA (March 2016). Retrieved from http:icfa.fnal.gov/what-why-who, 10/29/2018.

[53] Union der deutschen Akademien der Wissenschaften, "Amaldi Conferences," (2014). Retrieved from https://www.akademienunion.de/en/the-union/international-relations/amaldi-conferences/, 10/29/2018

[4] "Technological Opportunities to Increase the Proliferation Resistance of Global Civilian Nuclear Power Systems (TOPS)," Office of Nuclear Energy (n.d.). Retrieved from https://www.energy.gov/ne/downloads/technological-opportunities-increase-proliferation-resistance-global, 10/29/2018

of this academic center, including undergraduate courses, are located in Series II (Stanford University). Additional information regarding the Center may also be found in the Stanford University Archives.

V A: Congressional Antiballistic Missile Hearings and Testimony, 1969-1996
V B: Energy Research Advisory Board (ERAB), 1978-1990
V C: Geneva Conferences on Discontinuance of Nuclear Weapons Tests (Technical Working Groups) 1959
V D: High Energy Physics Advisory Panel (HEPAP), 1965-1985 bulk (1954-2000 inclusive)
V E: JASON, 1964-2007
V F: National Academy of Sciences (NAS): Committee on Science, Engineering, and Public Policy (COSEPUP), 1982-1984
V G: NAS: Other, 2000-2005 bulk (1964-2005 inclusive)
V H: NAS Committee on Scientific Communication and National Security (CSCNS), 1982-1984
V I: NAS Committee on International Security and Arms Control (CISAC), 1960-2007
V J: NAS Inertial Confinement Fusion (ICF) Review Committee, 1978-1985
V K: Office of Science and Technology Policy (OSTP), 1971-1980
V L: Presidential Science Advising, 1958-2001
V M: Strategic Arms Limitation Treaty (SALT), 1971-1999
V N: Superconducting Super Collider (SSC) Board of Overseers (BoO), 1983-2001
V O: U.S.S.R., 1953-2004
V P: China, 1972-2007
V Q: Germany, 1994-1996 bulk (1956-2000 inclusive)
V R: Japan and Korea, 1976-2004
V S: Arms Control and Disarmament (subject files), 1957-2007
V T: Civil Defense (subject files), 1958-2000
V U: Nuclear Safety and Materials (subject files), 1963-2007
V V: Union of Concerned Scientists, 2001-2004
V W: Amaldi Conferences, 1987-2007
V X: Department of Energy (DOE) and Predecessor Agencies, 1950-2007
V Y: International Committee for Future Accelerators (ICFA), 1975-1979, 1987 bulk (1960-1992 inclusive)

SERIES VI: AMERICAN PHYSICAL SOCIETY (Includes President's Files 1974-1975), 1974 bulk (1951-2004 inclusive)

Panofsky served as President of the Society in 1974. This series consists of his presidential files, including membership and committee files, meetings, long range planning (1973-74), an energy conservation study, correspondence and a Congressional bill concerning the Council on Science and Technology, and files on the American Association of Physics Teachers (AAPT).

Additional material can be found in the records of the American Physical Society (APS) at the American Institute of Physics (AIP), College Park, Maryland.

SERIES VII: PROFESSIONAL ACTIVITIES AND PUBLICATIONS, 1937-2008

This series consists of documents related to Panofsky's professional activities; a chronological arrangement of Panofsky's lectures; published books (including a textbook written with Melba Phillips and his autobiography co-authored by SLAC Senior Archivist Jean Deken), articles, and related materials. A compilation of Panofsky's publications researched by former SLAC Librarian Kim Sutton is included with a numbered index from SPIRES-HEP (Stanford Physics Information Retrieval System-High Energy Physics), SLAC's database of particle physics literature. In general, there is less documentation in this series of organizations in which Dr. Panofsky served in lesser roles. Dr. Panofsky was a member of the Council on Foreign Relations from 1974 to 2004. Information concerning Panofsky's work as a consultant with organizations such as Annual Reviews, Inc., a non-profit corporation on whose board of directors he served, is included at the end of the series.

VII A: Conferences, 1957-2006
VII B: American Academy of Arts & Sciences (AAAS), 1962-2007 inclusive
VII C: American Nuclear Society (ANS), 1994 (1 file)
VII D: Council on Foreign Relations, 1974-2006
VII E: Federation of American Scientists (FAS), 1962-1989 (1 file)
VII F: Pugwash/COSWA (Committee on Science and World Affairs), 1961-2000
VII G: Lectures, 1953-2007
VII H: The Book with Melba Phillips (*Classical Electricity and Magnetism*, 1951), 1951-2006
VII I: Publications, 1984-2007 bulk (1937-2008 inclusive)
VII J: The Book with Deken (*Panofsky on Physics, Politics and Peace: Pief Remembers*, 2007) 2006
VII K: Consulting, 1959-2003

SERIES VIII: CORRESPONDENCE, 1932-2007

This series consists primarily of two sections reflecting a change in administrative organization in the 1980s, with files arranged in alphabetical order by correspondent. Notable inclusions are correspondence and speeches in honor of Jesse Dumond and files related to Panofsky's memoir of Ed McMillan. As a prolific contributor of editorials, Panofsky demonstrated his concern for a public dialogue regarding international arms control issues, and several of his letters and commentaries are included in the last subseries.

VIII A: Correspondence, 1945 - early 1990s
VIII B: Correspondence, Late 1980s - 2007 bulk (1932-2007 inclusive)
VIII C: Letters to Editor, Commentaries, Editorials, 1950-2006

SERIES IX: PERSONAL DOCUMENTATION, 1942-2007

The penultimate series consists of personal documentation, including biographical information (interviews and articles), personal clippings, appointment diaries, and awards. Dr. Panofsky also designed an aperiodic stabilizer for instruments on ships. Related patent documents were originally transferred to Stanford University's Hoover Institution and later returned.

IX A: Biographical Statements, Bibliographies, etc., 1974-2007
IX B: Articles about Panofsky, 1984-2005 bulk (1957-2005 inclusive)
IX C: Awards and Honors, 1961-2004
IX D: Patents, 1942-1969

SERIES X: Other (Multimedia and Artifacts), 1936-2008

The final series consists of photographs, multimedia (including audiotapes of meetings in China in the 1980s), and realia. The photographs include a collection from the Panofsky family that have been digitized, as well as copies of SLAC photograph. Also included are Panofsky's personal copies of historic reports (primarily authorizing AEC legislation from Congressional hearings). Memorials, obituaries, and tributes for Panofsky collected by the Archives are included in the last subseries for reference.

X A: Photographs, 1936-2006
X B: Multimedia (Videotapes, Audiotapes, CD-ROMs, diskettes), 1962-2007
X C: Artifacts (and other oversize material), 1962-2003 bulk (1936-2003 inclusive)
X D: Personal Copies of Publications and Reports, 1959-1998
X E: Panofsky Memorials and Tributes, 2007-2008

Related Material

Materials related to Panofsky's life and work can also be found among files transferred to the SLAC Archives, History & Records Office holdings by Dr. Burton Richter, director of SLAC from 1984 - 1998. Correspondence regarding Project M can be found in the papers of Frederick Pindar, first director of the lab's business division. Photographs of Panofsky are available in SALLIE (Stanford ALL-Image Exchange), Stanford's digital image repository, in both the SLAC and the News Service collections. Related photographs can also be found in the AHRO's analog collections of SLAC photographers' output. Other materials in the SLAC AHRO may relate to the topics in this archive. See the archivist for further research assistance.

Material regarding Panofsky as Stanford professor and director of the High Energy Physics Laboratory, and on the development of Project M, can be found in the Stanford University Archives in such collections as the papers of professors Leonard Schiff (physics), Felix Bloch (physics), and Edward Ginzton (applied physics) and in the records of Presidents J. E. Wallace Sterling, Kenneth Pitzer, and Richard W. Lyman. Stanford News Service photographs of Panofsky, including portraits and several SLAC-related events, can be downloaded from SALLIE or requested by contacting the News Service Library. For further information regarding Stanford University, its Physics Department and the High Energy Physics Laboratory, contact the University Archivist, Department of Special Collections, Green Library, Stanford University, Stanford, CA 94305, (universityarchives@stanford.edu).