



IN MEMORIAM

Chang- Lin Tien
Professor of Mechanical Engineering, Emeritus
Chancellor, Emeritus
University Professor, Emeritus
Berkeley, Irvine
1935 — 2002

Chang- Lin Tien, university professor emeritus and the seventh chancellor of the University of California, Berkeley, was born July 24, 1935, in Wuhan, China. In 1949, at age 14, he and his family fled China's Communist regime for Taiwan. With an undergraduate degree from National Taiwan University, Tien arrived in the United States in 1956 to study at the University of Louisville. He earned his master's degree there in 1957 and then, two years later, a second master's degree and his Ph.D. in mechanical engineering at Princeton University in 1959.

Later in 1959, at age 24, he became the youngest assistant professor ever hired in mechanical engineering at UC Berkeley, where he would subsequently serve as a faculty member for 42 years. He became full professor in 1968, later chaired the Department of Mechanical Engineering for seven years and, for two years, 1983-85, was UC Berkeley's vice chancellor for research. In 1988, Tien left the Berkeley campus to be UC Irvine's executive vice chancellor. He returned to UC Berkeley in 1990 as chancellor and as the first Asian American to head a major research university in the United States.

During his seven- year term as chancellor, the campus was confronted with two major crises: a severe decline in state resources resulting from a prolonged downturn in the economy, and the ending of racial preferences in admission by Regental decision in July 1995.

In the period 1991 to 1994, the Berkeley campus lost \$70 million in state revenue out of a total budget of approximately \$370 million. A voluntary early retirement program was instituted by the Office of the President that led to the departure of approximately 400 faculty over a three- year period. In the third year of this program, Tien insisted, with a threat of resignation, on modifications to reduce faculty attrition. He was an indefatigable champion of Berkeley and was personally responsible for warding off numerous offers from Ivy League schools to Berkeley faculty. He was also instrumental in recruiting a host of exceptional young faculty to replenish the ranks.

In addition to successfully reversing the effects of major state budget cuts in the early 1990s, Chancellor Tien developed approaches to counter the impacts of the 1995 UC Regents' ban on racial preferences in admission. He launched the Berkeley Pledge, a nationally- recognized partnership between UC Berkeley and California's K-12 public schools that today is called School/ University Partnerships. Tien took his salary increase for that year and donated it to the program, and the Berkeley Pledge became a model for such programs throughout the nation. Tien was a legendary fundraiser and an international ambassador for Berkeley. In initiating the New Century Campaign for the campus in 1993, he set what many thought was a totally unrealistic goal of \$1.1 billion. When the campaign ended in 2001, \$1.3 billion had been raised.

As chancellor, Tien was also an unofficial diplomat in Asia, meeting with heads of state and other leaders to promote the American values of democracy and freedom. He helped found the Committee of 100, a nonpartisan group of Chinese Americans that works to foster dialogue and understanding between Asia and

the United States. He was an active member of the Pacific Council on International Policy, the Council on Foreign Relations, and many others. Indicative of the scope of his leadership in both domestic and international arenas were his appointments as chairman of the Asia Foundation, chairman of the San Francisco Bay Area Economic Forum, and chairman of the Chief Executive's Commission on Innovation and Technology in Hong Kong. In 1999, Dr. Tien was appointed a member of the U.S. National Science Board and the U.S. National Commission on Mathematics and Science Teaching for the 21st Century. He also served as co-chair of the National Commission on Asia in the Schools.

Tien's deep commitment to education was evidenced in a multitude of ways at Berkeley. In 1962, at age 26, he became the youngest professor to receive Berkeley's Distinguished Teaching Award. Later, as chancellor, he worked to improve the environment for all students. Berkeley was noted for its long lines at the financial aid office and the registrar's office in Sproul Hall at the beginning of every school year. As one of his first acts as chancellor, Tien instituted a "Smooth Transition" program. Soon the lines were gone and every effort was made to make the new students comfortable and at home in Berkeley. His concern for students, undergraduate and graduate, became legendary. He was a ubiquitous presence on campus at all hours of the day and night. He would bring cookies to the students in the library studying for their final exams. He would give students a ride back to the dormitories after leaving his office late at night. He would work with his doctoral students all night long, knowing that he could get some sleep on an early plane to Washington, D.C. in the morning. In 1992, he instituted the Freshmen Seminar Program to provide entering students with more intimate classes (enrollment was limited to 15) with ladder-rank faculty. Tien was honored in 1997 by the award of the first Presidential Medal from UC President Richard Atkinson. In 2001, he received the Berkeley Citation, in recognition of both his notable service to the University and achievement in his field.

During his 42-year research career, Tien mentored over 60 doctoral students, and even as chancellor, the students of his research group continued to make major research contributions. Today, many of his former graduate students are professors themselves, and are mentoring yet another generation of graduate students with vital lessons that Tien taught. These lessons were best summarized by his former student Richard Buckius, who has said, "He was forever asking, 'Any new ideas?' and telling us, 'Go to the extremes,' 'Ideas should be crazy enough to be rejected by your peers,' and 'Sometimes the simple solutions have the greatest impact.'"

Since his graduate days at Louisville and Princeton, and through his academic life at Berkeley, Chang-Lin Tien dedicated his research career to thermal science and engineering. By the time of his retirement in 2001, he had made contributions to almost all aspects of this field and was responsible for starting many of them. Impacts of his research and scholarship can be judged by the many awards that he received: Max Jacob Memorial Award (1981), National Academy of Engineering (1976), National Science Foundation Distinguished Lecturer in Engineering (1997), Chinese Academy of Sciences (1994), Honorary Member, American Society of Mechanical Engineers (ASME, 1993), ASME Heat Transfer Classic Paper Award (1999), and the National Academy of Engineering's Founders Award.

The hallmark of Chang-Lin Tien's research was to explore, understand, and exploit the extremes – ultralarge and ultrasmall length and time scales, ultrahigh and ultralow heat flow rates and temperature, etc. Starting in the 1960s, after working briefly on hydrodynamics and heat transfer of boundary layer flows, he focused his efforts on radiation heat transfer. His initial emphasis was on radiative properties of gases, which led to the landmark paper in *Advances in Heat Transfer* on this topic. He brought a new engineering approach based on the fundamental science of radiation-matter interactions, which involves understanding complex quantum and statistical mechanical interactions of photons with molecules, and then developing design rules that capture the essential physics while being tractable for engineering design. His approach had a major influence on various technologies, most notably aerospace and energy.

Spanning the 1960s and 1970s, he also investigated radiative heat transfer in cryogenic systems as well as interaction of radiation with particulates, fibers and various other micro/nanostructured solids. His work became the cornerstone of designing materials for space shuttle thermal protection, packed bed reactors, radiative heat pipes for space thermal management, ultrahigh thermal insulation, as well as high-efficiency and environmentally benign combustion systems. Later in the 1980s and 1990s, he expanded his research to radiation-surface interactions, especially in combustion systems, and ventured into the new topic of femtosecond and nanometer-scale radiation-matter interactions. It is worth noting that in the 1960s Chang-Lin Tien received much recognition for his work on near-field radiation heat transfer, which was used to improve cryogenic insulation. This work has now become a classic in the new and emerging field of micro/nanoscale heat transfer.

While many would have been satisfied with this range of contributions, Chang- Lin Tien's research repertoire included much more. Starting in the 1970s, much of his research effort concentrated on multiphase and multicomponent flows and heat transfer. Responding to the energy crisis in the 1970s, his work led to major contributions in heat and mass transfer in porous media, condensation, two- phase flows, and granular flows. In particular, he investigated the fundamental mechanisms of mixing, dispersion, and flow channeling near a wall in complex media, which led to breakthroughs in our understanding. His work had significant impact in the design and operation of thermal insulation, drying technology, catalytic and packed bed reactors, geothermal systems, heat pipes, and nuclear reactors. His work on flow channeling at the interface of a porous and solid wall received the Classic Paper Award of the American Society of Mechanical Engineers some 20 years later, due to its influence on the field and its positive impact on the petroleum industries, as well as in microelectronics thermal management.

The 1980s and 1990s saw the emergence of the digital computers and information science as a major technological revolution. An underlying theme of this revolution is miniaturization and integration, which presents new opportunities and challenges in thermal science and engineering. Recognizing this as a critical transition in heat transfer research and following his quest for the extremes, Chang- Lin Tien single- handedly galvanized the heat transfer community, especially the young, and pioneered the field of micro/ nanoscale thermal science and engineering. Following his instincts of discovering new physics at ultrasmall length and time scales, his research led to investigations of phonon, photon, and electron dynamics in solid and liquid nanostructures and at femtosecond timescales. He left his mark on this field, again by combining fundamental science with engineering design. While his research on micro/ nanoscale heat transfer can be traced back to the 1960s, he realized earlier than most in the 1980s that there was the possibility of a whole new technology based on nanoscale science and engineering, which would form the infrastructure and the foundation for future progress in information technology and biotechnology. This has become one of the most exciting areas of research, not only with the heat transfer community, but also mechanical engineering in general.

In November 1995, Tien's colleagues and former students gathered at Berkeley for a symposium to honor his research contributions, on the occasion of his 60th birthday. During this daylong symposium, these researchers presented over 60 research papers, all in areas where Tien had made earlier, seminal contributions, and presented these research papers to him in a bound volume that now resides in Berkeley's Kresge Engineering Library. Chang- Lin Tien was diagnosed with a brain tumor and suffered a debilitating stroke in September 2001. At the retirement symposium held on June 22, 2002, some 200 colleagues, friends, and former students gathered at Berkeley, and more joined the symposium via the World Wide Web, to mark Tien's retirement and to honor his 42 years of service to the University, the nation, and the world. Sadly, only four months later on October 29, 2002, Chang- Lin Tien died at the age of 67 at Kaiser Permanente Hospital in Redwood City, California. At the memorial service held November 14, over 1,500 people filled Zellerbach Hall to mourn this enormous loss and to celebrate Chang- Lin Tien's extraordinary life of scholarship, service, and tremendous accomplishment. Professor Tien is survived by his wife, Di- Hwa; son, Norman; daughters Phyllis and Christine; and four grandchildren. May Chang- Lin Tien's soul rest in peace, and his spirit live on among all of us who have been touched by his intellect and humanity.

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