



YUAN-CHENG B. FUNG

1919–2019

Elected in 1979

*“Contributions to the theory of elasticity and aeroelasticity,
and applications to bioengineering.”*

SUBMITTED BY THE NAE HOME SECRETARY

YUAN-CHENG “BERT” FUNG, known as “the father of biomechanics” and one of the founders of the discipline of bioengineering at the University of California San Diego, passed away December 15, 2019, of natural causes. He was 100 years old.

He was the first to realize that physics and mechanics apply to living tissues just as they do to synthetic structures, giving rise to the field of biomechanics. Later, he coined the term *tissue engineering*.

“After many years in the field, I really think that an interdisciplinary area is not just the one area plus another,” he said in an extensive oral history recorded for IEEE in 2000. “It’s the new product in between, which is neither of the mother fields. The interesting part is the new in-between part.”

Fung was born September 15, 1919, in Changzhou, China, and earned his BS (1941) and MS (1943) degrees in aeronautics from the National Central University. After World War II he came to the United States to pursue a PhD (1948), also in aeronautics, at Caltech. When he first stepped off the boat upon arriving in the United States, the Red Cross gave him a coffee

Adapted from <https://ucsdnews.ucsd.edu/pressrelease/obituary-y.c-bert-fung>.

and a doughnut. The organization remained close to his heart ever after, his children said.

Fung quickly became an expert in the field of aeroelasticity—the study of the interaction of aerodynamic forces with structures that aren't rigid—and led a renowned research group at Caltech. In 1955 he published what became the leading textbook on the subject¹; over the years, he also authored *Foundations of Solid Mechanics, A First Course in Continuum Mechanics*, and a series of books on biomechanics; and he was a principal founder of the *Journal of Biomechanics*.

It was a personal experience in 1958 that changed the direction of his research. While he was on sabbatical in Germany, his mother developed acute glaucoma back home in China. Fung immersed himself in all the research available on the condition. He translated the latest journal articles and sent them to his mother's physicians. But it quickly became evident to him that not much was known about the mechanical forces and physical phenomena to which living tissues are subjected. This was his first step toward focusing on bioengineering.

After joining the UC San Diego faculty in 1966 he became one of the founders of its bioengineering program, along with fellow researchers Benjamin W. Zweifach and Marcos Intaglietta. Over the following half-century, with his colleagues and students Fung studied and analyzed the mechanics at work in virtually all living tissues—blood vessels, skin, muscle, cartilage, heart, lung, and more.

He studied the mechanics of blood flow through microcirculation (the circulation of blood in the smallest blood vessels). He developed the "sheet-flow" theory, which provides a quantitative description of pulmonary circulation, hypertension, edema, and respiratory distress syndrome in the lung.

He formulated the exponential Fung's Law describing how soft tissue deforms under stress. The law was integral to the development of artificial skin grafts that mimic the skin's properties and are used to help burn victims heal. In addition,

¹ Fung YC. 1955. *An Introduction to the Theory of Aeroelasticity*. Hoboken NJ: John Wiley & Sons.

all safety crash tests for motor vehicles today rely on Fung's Law and his fundamental studies of tissue mechanics.

Beyond the UCSD campus, he chaired the International Applied Mechanics Division of the the American Society of Mechanical Engineers and in 1972 established the ASME Biomechanics Symposium, which became the annual Summer Bioengineering Conference.

For his outstanding contributions Fung received a National Medal of Science in 2000, the first bioengineer to earn the distinction. He was the fourth individual in history elected to all three of the National Academies—Sciences (1992), Engineering (1979), and Medicine (1991)—and was also elected to the Academia Sinica (1968) and Chinese Academy of Sciences (1994, as a foreign member). Among his many awards, he received the Theodore von Karman Medal in Engineering Mechanics (1976), the Timoshenko Medal (1991), and the NAE's Fritz J. and Dolores H. Russ Prize (2007, "for the characterization and modeling of human tissue mechanics and function leading to prevention and mitigation of trauma"). His favorite honor was the NAE Founders Award (1998), because it was bestowed by his peers, said his son, Conrad Fung.

In addition to his scholarship, Fung was a very effective teacher and mentor. A number of the PhD students and post-doctoral researchers he mentored went on to lead bioengineering and biomedical engineering departments around the United States. Many have the same story: They heard Fung talk during a seminar and were instantly impressed; as they lingered afterward they found that he was personable and easily approachable. Soon, they transferred to UC San Diego to be part of his research group, where he encouraged them to be creative and do pioneering work.

His guiding principle was "Take it easy. And work hard," said Conrad. That might sound like a paradox, but to Fung it meant that it was important to set clear goals and keep them in mind while working hard without second-guessing and fretting. He passed this on to his students, telling them that engineers should be able to turn any complicated problem into a simple problem. "A problem is like a tree that is full of leaves

in summer but loses all of them in fall so you can see things more clearly," said Michael Yen, one of Fung's PhD students and postdocs who joined the UCSD faculty.

Yen accompanied Fung on a trip to China, where Fung had been invited for a 1-month lecture tour to help kickstart bioengineering programs after the end of the Cultural Revolution. "Everywhere we went, he wanted to help the poor and the needy," Yen said. "I learned from him to be concerned about people's humanity."

Fung's laugh was another of his distinctive qualities. "He was the most joyful individual," said Geert Schmid-Schoenbein, professor of bioengineering at UC San Diego and one of Fung's former PhD students. "When you stepped into a building, you could tell where he was just by the sound of his laughter."

That laughter was last heard on the UCSD campus in September 2019, when Fung visited for a celebration of his 100th birthday. More than 100 researchers from as far as Israel, Taiwan, Singapore, and China came together for the occasion.

Shu Chien, who was recruited by Fung to come to UC San Diego from Columbia University, studied how blood flow and pressure affect vessels (and received a National Medal of Science in 2011). In a paper he prepared for Fung's 100th birthday, Chien wrote, "Through his vision of the power of 'model making' to explain and predict biological phenomena, Dr. Fung opened up a new vista for bioengineering." He added that Fung was "also a wonderful artist. He has excellent command in Chinese calligraphy and poetry. He is a Renaissance man."

Fung's wife, Luna Yu Hsien-Shih, gave up her career as a mathematician and helped found and develop the UC San Diego International Center, said Conrad Fung. She passed away in 2017.

Fung is survived by his children Conrad A. Fung of Brookfield, Wisconsin, and Brenda Fung Manos of Belmont, Massachusetts, and three grandsons.

