

MEMORIAL RESOLUTION WILHELM FLÜGGE (1904 - 1990)

After a period of declining health, Wilhelm Flügge died at his home in Los Altos, California, on Monday, March 19, 1990, one day after his 86th birthday.

Wilhelm Flügge was born on March 18, 1904, in Greiz, then a capital of a little principality which was later incorporated into a state of the German Republic. His father was a protestant minister who took the family to Dresden when Wilhelm was at the age of six. There he graduated from high school in 1921 and the Technical University, with the Diploma of Engineer (Dip. -Ing.) in Civil Engineering, in 1925. After serving as an assistant to Professor K. Beyer, he received the Doctor of Engineering (Dr. -Ing.) in 1927. For the next three years in Leipzig and Wiesbaden, he was involved in the development of new ideas of thin-shell construction in reinforced concrete for factories, train stations and observatories. In 1930, he accepted an appointment for post-doctoral work at the University of Göttingen, then a leading center of mathematics, engineering, and science with such prominent figures as Hilbert and Prandtl. Flügge became Privat-Dozent (comparable to an assistant professor) in 1932. He was co-founder of the journal *Zentralblatt für Mechanik* in 1933. A major event of the Göttingen years was the meeting of Wilhelm Flügge and Irmgard Lotz, who was a research worker in Prandtl's group, devoted to fundamental questions of fluid dynamics. The "Lotz method" for calculating the lift on a three-dimensional wing was devised at that time, which became a standard technique used internationally. However, the position of a female in the world of science and engineering was difficult. Wilhelm has told of the secretary who served tea to the group at the weekly conference, but refused to serve Irmgard: "She can make her own tea."

In 1934 Flügge published the book for which he is widely known, *Statik und Dynamik der Schalen*, the first text on the theory of shell structures. Several editions have been published of the German text and of the updated English version, which first appeared in 1960 as *Stresses in Shells*. For almost twenty

years, this book held a unique place for engineers the world over. It served as the handbook for designers of concrete roofs, pressure vessels for storage and power generation, as well as aircraft, and served as the established point of departure for countless analytical and experimental research investigations. Even after numerous other texts on the subject have appeared, this book continues to occupy the position of primary reference. A significant portion consists of original work by Flügge which is the standard of comparison, often referred to as “classical”, for both simpler and more elaborate theories. Among his subsequent publications was the *Handbook of Engineering Mechanics*, 1962.

Despite his technical accomplishments, shortly after the turnover in Germany in 1933, Flügge was branded as “politically unreliable” and lost all hope for a university career. Employment came in 1938, when he accepted the position of department head in the Deutschland Versuchsanstalt Luftfahrt (DVL) in Berlin, the German equivalent of NASA. Göring was more interested in competence than political and racial purity in developing the German aircraft industry. About that time, Wilhelm married Irmgard Lotz, who had been appointed head of the fluid mechanics section of DVL. In the spring of 1944, the destruction of Berlin had progressed so far that Wilhelm and Irmgard moved with their departments to Saulgau, a little town in the hills of southern Germany. After the end of the war, Saulgau was in the French zone of occupation. The French aeronautical establishment was resurrected after the war on an enlarged scale and was eager to take in the German intelligentsia. In 1947 Wilhelm Flügge and Irmgard Flügge-Lotz moved with many of their co-workers to Paris, to become part of the Office National d’Études et de Recherches Aéronautiques (ONERA). Life in Paris was pleasant, but professionally with limited future. A casual letter of inquiry about the possibility of a job in the United States to Professor Stephen Timoshenko led to a quick offer of a position as Professor at Stanford University. Timoshenko deserves the credit for bringing mathematical analysis into engineering practice, certainly in the area of structures. He realized the advantage of bringing Wilhelm Flügge to strengthen the work in applied mechanics at Stanford. He was, apparently, not so interested in fluids. With the University policy that husband and wife could not hold professional rank in the same department, the consequence was that Irmgard Flügge-Lotz was only tolerated in the position of “lecturer.” The irony is that in addition to her work in fluids, she was one of the pioneers in the field of discontinuous automatic control. Nearly twenty years later as she approached retirement, she belatedly received the appointment as Professor.

In their twenty years of active service at Stanford University Wilhelm Flügge and Irmgard Flügge-Lotz provided inspiration to students and col-

leagues. Some seventy Ph.D. theses were completed under their direction. Neither lost the fairly heavy accent in English, possibly because they decided when arriving in America to speak only English to each other. However, when Wilhelm would explain in a lecture how one should (conceptually) “put the fingers there on and bend”, the message of combining basic physical interpretation with mathematics was crystal clear. The Flügges did not have children, but possibly compensated by adopting, in their own formal way, all the mechanics colleagues, students, and visitors. A regular schedule of inviting people for evening tea at their home in Los Altos was maintained.

Irmgard died in 1974, only a few years after her retirement, leaving Wilhelm alone for the past sixteen years. He maintained the home exactly as it was with her, occasionally inviting guests for evening tea and on rarer occasions preparing an elaborate meal for guests. The spirit of Irmgard was always present. After his retirement, Wilhelm finished the books *Viscoelasticity* and *Tensorial Methods in Continuum Mechanics*. Subsequently, he devoted his attention to his hobbies of photography, bird watching, a cactus collection, and traveling. Many will remember the unique Christmas cards he would prepare, featuring an interesting angle photograph of his latest little creation, such as a quizzical owl from a pine cone. He was originally attracted to civil engineering for the opportunity to build beautiful structures. A source of regret for his career was that so much of the effort for beautiful structures and beautiful mechanics was applied to destructive purposes.

Wilhelm Flügge received many honors, including the von Kármán Medal of the American Society of Civil Engineers and the Worcester Reed Warner Medal of the American Society of Mechanical Engineers. In December, 1989, a banquet was held in San Francisco in honor of his 85th birthday, which was attended by about fifty friends and former students from all parts of the country. He delivered his typical sharp perspective on the state of the world and current engineering. It seems to be no coincidence that he died on the day after his 86th birthday. On that day his driver's license expired and could not be renewed because of failing eyesight, as well as failing strength. He simply was not willing to yield the home he shared with Irmgard, nor his independence. His departure marks the end of an era.

Wilhelm Flügge is survived by a brother Professor Siegfried Flügge of Hinterzarten, Germany, who was editor of the comprehensive *Handbuch der Physik*, and a niece Dr. Gertrud Farber of Chicago, Illinois. The “Wilhelm Flügge and Irmgard Flügge-Lotz Memorial Award”, for the outstanding graduate student each year, has been established in the Applied Mechanics Division of Stanford University.

James Gere
George Herrmann
Charles R. Steele