

MEMORIAL RESOLUTION

IRMGARD FLÜGGE-LOTZ (1903 – 1974)

Irmgard Flügge-Lotz, Professor Emeritus of Applied Mechanics and of Aeronautics and Astronautics, and Stanford's first woman professor of engineering, died at Stanford Hospital on May 22 at the age of 70 following a lengthy illness. She was internationally renowned for her many important contributions to aerodynamics and to automatic control theory. Within Stanford, Dean William M. Kays considered her to be "one of our most distinguished professors by any standard of "measure." Recent honors attesting to her eminence include an honorary Doctor of Science degree by the University of Maryland in 1973, the Achievement Award by the Society of Women Engineers in 1970, and selection by the American Institute of Aeronautics and Astronautics to give the prestigious von Kármán Lecture in 1971. She was the first woman elected to the grade of Fellow by the latter organization, was a Senior Member of the Institute of Electrical and Electronic Engineers, a member of Sigma Xi, and served on the advisory board of several scientific journals. She published over 50 technical papers and authored two books.

Irmgard Lotz, born in Hameln, Germany on July 16, 1903 began her climb to engineering prominence with a childhood fascination with the art of construction, a business in which her mother's family has been engaged for several generations. She early acquired an acquaintance with practical aspects of such work by going with members of her family to visit construction sites, as well as to watch airship tests being conducted near her home by Count von Zeppelin. Interest in mathematics was encouraged by her father, a mathematician of considerable talent. As she was fond of saying, however, her final decision to choose an engineering career was made because she wanted a life which would never be boring - a life in which new things would always occur".

Fräulein Lotz did both her undergraduate and graduate studies at the Technische Hochschule, Hanover, where she usually found herself the only girl in most classes in a school with more than 1,000 engineering students. After acquiring a Diploma of Engineering and a Doctor of Engineering degree, she accepted a position as a junior research engineer at the Aerodynamics Research Institute in Göttingen. There she worked closely with the leading pair of German aerodynamicists of the time, Professor Ludwig Prandtl and Albert Betz. Soon the young Dr. Lotz was making substantial advances in methods for the prediction of aerodynamic pressures on bodies, wings, and turbine blades. In several instances, these were adopted as standard procedures throughout the world. She stayed at Göttingen until 1938 by which time she had risen to be Head of the Department of Theoretical Aerodynamics. During this period, she met and married Dr. Wilhelm Flügge, then a young faculty member of the University of Göttingen and now Professor Emeritus of Applied Mechanics and Civil Engineering at Stanford. He survives her and lives in Los Altos.

In 1939, Dr. Flügge-Lotz and her husband moved to Berlin where she became a consultant on aerodynamics and flight dynamics at the DVL (German Aeronautical Research

Laboratory). There she commenced her career in automatic control theory, developing at first the theory of discontinuous, or on-off, control systems. Such controls, having only two or three input settings, are simple and inexpensive to manufacture and rugged and reliable in service; however a theory for their performance had to be developed before design could be undertaken with confidence. With the collapse of Germany in 1945, the Flüggés gathered several highly qualified colleagues and their families and moved to Paris to work for the ONERA (French National office for Aeronautical Research.). Dr. Flügge-Lotz served there as Chief of a Research Group in Theoretical Aerodynamics from 1946 to 1948.

In the fall of 1948, the Flüggés both accepted offers from Stanford University. He was appointed Professor, but she was appointed only as Lecturer in Engineering Mechanics and Research Supervisor. Lack of an appropriate title did not deter her from embarking upon a full and useful life of teaching and research at Stanford. She immediately undertook the guidance of Ph. D. dissertation research in aerodynamic theory, and in the spring of 1949 taught her first Stanford course, which was in boundary-layer theory. Before long she introduced a new year-long sequence of courses in mathematical hydro- and aerodynamics for first-year graduate students. At that time there were few full-time graduate students interested in fluid mechanics at Stanford, but there was a substantial number of young research engineers from Ames Research Center at Moffett Field who were using their vacation leave sparingly to attend Stanford on a part-time basis in order to acquire their M. S. and Ph. D. degrees. By her constant willingness to conduct research consultations late in the day or in the evenings at her home, she gained the lasting gratitude of many of these students. By 1951 the number of students had grown sufficiently that she established the weekly Fluid Mechanics Seminar which continues to this day to be an active and unifying forum for faculty and students from many departments to meet and exchange ideas and information on various aspects of fluid mechanics. As the years passed, she continued a strong interest in fluid mechanics, particularly in boundary-layer theory and numerical methods.

Not long after her arrival, Dr. Flügge-Lotz also began building a second role for herself at Stanford in the theory of automatic controls. She developed new courses in this important subject, and began guiding a succession of students into the intricacies of the field. In 1953 she published the book *Discontinuous Automatic Control* setting forth in one place many of the details of a decade and half of her own work as well as that of others. Since automatic control devices were often of an electrical nature, this work led also to an increasingly close contact with faculty and students in the Department of Electrical Engineering. While she always maintained a strong interest in fluid mechanics, with the passage of time her primary effort went more and more into control theory. Many important papers were written, and in 1968, the year of her retirement, she published her second book, *Discontinuous and Optimal Control*. Her von Kármán Lecture in 1971 entitled "Trends in the Field of Automatic Control in the Last Two Decades" provided a valuable and succinct summary of outstanding advances in the formative years of automatic control theory.

By the middle 1950's, it seemed evident to almost everyone at Stanford that Dr. Flügge-Lotz was carrying on all the duties of a full professor, but without official recognition. In fact, it was hard for students to understand why she was a Lecturer rather than a Professor, or even what the difference meant. The same question arose on the international scene in the summer of 1960 when she was the only woman delegate from the United States at the First Congress of the International Federation of Automatic Control, in Moscow. By then, the disparity had become

apparent to all. Before school opened for autumn quarter, she was appointed to the rank of full Professor in both Engineering Mechanics and Aeronautics and Astronautics.

In the years following, Professor Flügge-Lotz continued her busy career of teaching and research. She and her husband always exhibited great interest in knowing their students well, and invited them frequently to dinner parties at their home, where carefully selected mixes of faculty, students, and visitors were brought together for evenings of good food and conversation. While her teaching stopped with retirement, her research on problems of satellite control and of heat transfer and drag of high-speed vehicles continued actively right to the end. This was the more remarkable because of the constant pain and discomfort with which she lived for many years as disabling arthritis attacked first one part and then another of her body. Through it all, she kept her good spirits and maintained frequent contacts with friends and colleagues, all of whom were sadly shocked by her sudden death.

Irmgard Flügge-Lotz, teacher, researcher, friend, and gracious hostess, set out on her career hoping never to be bored - there is every indication she achieved her goal. In everything, whether helping students, pursuing her professional work, or bringing together an interesting group of people for an evening of quiet conversation, she displayed enthusiasm, good humor, and a sense of purpose and accomplishment. Hers was indeed a "life full of work", as suggested by the title of a biographical article that appeared in the Stanford Engineering News shortly after her retirement. It was, moreover, a useful and inspiring endeavor from which she derived great pleasure. Professor Flügge-Lotz's presence will be missed in many ways but her influence will continue - both here at Stanford which she served so well, and in the wider community where her work finds application. She will always be remembered with affection and esteem by her colleagues, and by a generation of Stanford engineering students.

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