

In memoriam - Polina S. Landa (15 February 1931 – 21 October 2022)

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Professor Polina Solomonovna Landa died on October 21, 2022. She was a Doctor of Physical and Mathematical Sciences, a member of the Russian National Committee on Theoretical and Applied Mechanics, and an internationally recognized authority on the theory of nonlinear oscillations and waves.

Polina was born in Kyiv on February 15, 1931. With the outbreak of war, her family was evacuated to the Urals, first to the village of Byngi in the Sverdlovsk region, and then to Sverdlovsk itself. Soon after the end of the war, the family moved to Moscow. Polina graduated from high school in 1948 with a gold medal, enabling her to enter the Physics Department of Moscow State University without formal entry examinations. In 1953, she received her diploma with honors and was assigned to

work in a classified enterprise known as "mail box". In 1956, she returned to her alma mater and worked there for the rest of her professional life, until 2020.

Polina defended her Ph.D. thesis entitled "On the stability of self-oscillatory systems and automatic control systems in the presence of random influences" in 1960. Her supervisor was Professor Sergei Pavlovich Strelkov - a student and collaborator of academicians L.I. Mandelstam and A.A. Andronov, the founders of the famous Soviet school working on the theory of oscillations. During the rest of her scientific life, Polina made innumerable contributions to the continued development of the school, helping to maintain its traditions, and eventually becoming its most senior member. Interestingly, in her Ph.D. years, Polina published five papers, only one of which was co-authored with her supervisor: in three publications she was sole author, and the fifth paper was written with her colleague, R.L. Stratonovich, with whom she continued collaborating for many years.

After defending her thesis, Polina continued to work on related topics, investigating the flutter of aircraft wings and the effect of noise on self-oscillators while, at the same time, she took up new tasks. The main direction of her work during those years was the study of natural fluctuations, self-oscillatory regimes and mode-locking in lasers. Based on the results of these works, Polina applied for a higher doctorate (equivalent to a DSc) and in 1972 she defended her doctoral dissertation on the topic "Investigation of the dynamic and statistical characteristics of optical quantum generators and amplifiers". In addition to numerous articles on this subject, she and co-authors published a monograph [1] and a review in *Uspekhi* [2].

Another area of interest for Polina was the study of ionization waves (striations) in plasma. Her activity originated in seeking the solutions to applied problems. Discharge stratification was found to appear in the plasma of helium-neon lasers operating on direct current. This was an undesirable phenomenon that made the reliable operation of helium-neon laser gyroscopes impossible. Polina considered the conditions that gave rise to the self-excitation of striations in low-temperature plasma, and devised methods for their asynchronous suppression. In addition to a large sequence of papers on this subject, she published a major review in *Uspekhi* [3].

Polina's scientific interests were always focused on general questions in the theory of vibrations. In the early 1980s, she published two books on the fundamental theory of self-oscillations [4, 5]. At the same time, she was engaged in research within the rapidly developing field of chaotic dynamics. She was especially interested in intermittency, the interaction of chaotic and periodic systems, mechanisms underlying the occurrence of irregular dynamics in self-oscillatory systems with inertial self-excitation, and in systems with delay, the "chaos-order" transition, analysis of chaotic systems using experimental data, and many other aspects. An important outcome of her work during this period was the monograph [6], published in 1987, which she co-authored with Yu.I. Neimark; the English edition of this book was published 5 years later.

At the end of the eighties, Polina solved a number of problems in acoustics. Her interests included the role of self-oscillations in the mechanisms of sound generation in liquid and gas flows, the generation of sound waves due to their interactions with heat sources, and the excitation of hydrodynamic and acoustic waves in subsonic jets and separated flows.

Polina encountered and overcame many difficulties in her career. She was Jewish and she was not a member of the Communist Party. In addition, like most Soviet scientists, Polina had no opportunity to participate in international scientific life until the arrival of perestroika in 1990. After that, she blossomed internationally. She gave presentations and worked as a visiting professor at universities in Germany, Italy, the USA and Great Britain. She was a member of the editorial board of the journal *Chaos, Solitons and Fractals* and of the journal *Izvestia VUZov. Applied Nonlinear Dynamics*. It was a fruitful period for her. During these years, she wrote and published monographs in English [7, 8], as well as numerous scientific articles on a wide variety of topics. Her most important works in these years are arguably those devoted to noise-induced transitions and transport, stochastic and vibrational resonance, acoustic influence on turbulent jets, and the vibrations of the vocal cords during sound generation. Her paper on vibrational resonance [9] initiated a new sub-field. In addition to the objects of study traditional for physicists, she analyzed such diverse processes as the economic development of society, the measurement of blood pressure, and features of the memory when performing arithmetic operations. Discussing these and other applications, Polina liked to emphasize that "the theory of oscillations is a universal science."

Polina put a lot of effort into her teaching. She developed and taught courses for both undergraduates and graduate students, including special topics such as "Self-oscillations in distributed systems", "Laser gyroscopes", "Nonlinear oscillations and waves", "Sound sources", and "Nonlinear dynamics". Twelve Ph.D. students completed their dissertations successfully under her supervision. She devoted a lot of time to her graduate students, trying to convey to them not only scientific knowledge, but also her honest and uncompromising attitude towards scientific activity. Helping her students in every possible way, Polina encouraged them to be independent and often insisted on their having publications without her co-authorship. Of course, she spoke about more than just science with her students. Realizing that she represented continuity for the traditions of the Soviet school on the theory of oscillations, she considered it important to tell her students about the dark pages in the history of Soviet science and, generally, about Stalin's repressions. She often mentioned that, in the first Russian edition of the celebrated and widely-used book [10], in 1937, the name of A.A. Vitt was omitted because, when the manuscript was completed, he was arrested and died in a concentration camp soon afterwards; she wrote a paper [11] paying tribute to his memory and scientific achievements. Many remember these conversations in her kitchen, over a cup of tea with her own home-made jam. As a teacher of young people she perceived her task to extend far beyond just guiding them to become qualified researchers. She encouraged them to think freely and honestly for themselves and, in her own words, to "understand what country they live in."

For those who had the good fortune to work with Polina, to learn from her, or to debate with her at seminars and conferences, she will never be forgotten.

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