

Lev Al'bertovich Vainstein (Obituary)

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Usp. Fiz. Nauk **160**, 87–89 (April 1990)

On 8 September 1989, the prominent Soviet physicist, Corresponding Member of the Academy of Sciences of the USSR, principal scientist of the USSR Academy of Sciences Institute of Physics Problems, Lev Al'bertovich Vainstein, died at 69 years of age (he was born 6 December 1920).

The scientific career of L. A. Vainstein was devoted to a wide range of theoretical issues associated with electrodynamics and electronics. He wrote more than 130 scientific papers and 9 monographs, which received world recognition, and many of his results are considered to be classical. L. A. Vainstein continued the traditions of the school of theoretical physics with which we associate the names of V. A. Fok and M. A. Leontovich. After completing work in the physics department and graduate work at the Moscow State University, L. A. Vainstein worked from 1946 to 1957 in one of the institutes associated with defense, and from 1957 to his last days was a member of the Institute of Physics Problems.

At the very beginning of his scientific career L. A. Vainstein solved a very difficult problem which was important for the subsequent development of the theory of diffraction, the problem of radiation from the open end of a waveguide. This work is comparable in importance to only one other classical key problem, the problem of the diffraction of a wave by a wedge, which was solved 50 years earlier by A. Sommerfeld. For this work L. A. Vainstein was awarded the L. I. Mandel'shtam Prize in 1947. Lev Al'bertovich succeeded in solving the problem by improving and applying the method of factorization. Later, he used this method to obtain a rigorous solution to a broad class of waveguide and antenna problems. The results of these works are described in the monographs "Difraktsiya elektromagnitnykh voln na otkrytom kontse volnovoda" (The Diffraction of Electromagnetic Waves at the Open End of a Waveguide, 1953) and "Teoriya difraktsii i metod faktorizatsii" (The Theory of Diffraction and the Method of Factorization, 1966).

The importance of these investigations and methods developed in their implementation has not diminished, even at present, especially if one considers that L. A. Vainstein used these methods to study successfully for the first time the properties of open resonators. In these resonators, with diameters which are large in comparison to the wavelength, only a small number of high- Q resonant oscillations can be stimulated. This amazing property of open resonators makes them irreplaceable in lasers and other devices operating in a wide range of wavelengths, from the optical portion of the spectrum to millimeter waves. In particular, L. A. Vainstein showed that even in resonators without caustics one can provide high- Q oscillations and rarefaction of their spectrum due to the characteristics of the diffraction of waves at the open ends of the waveguide forming the resonator. For a complete and comprehensive study of the properties of open resonators, L. A. Vainstein developed or improved a number



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of methods of calculation, such as the parabolic equation method, the method of approximate factorization, the geometric-optical method, the method of expansion in terms of functions of the continuous spectrum, etc. This series of fundamental investigations basically completed the theory of open resonators, and the results are presented in the monograph "Otkrytye resonatory i otkrytye volnovody" (Open Resonators and Open Waveguides, 1966). If one considers the importance of the many applications of open resonators, it is difficult to overestimate the practical value of their theoretical study. Allied with this subject are many investigations on electrodynamics associated with the numerical calculation of diffraction problems. In these studies L. A. Vainstein and his coauthors developed the double variation method, the method of double reduction, a means of calculating the diffraction of waves by metal grids, and the theory of thin vibrators, etc.

An extremely wide range of problems was studied and successfully resolved by L. A. Vainstein. He loved to repeat that in science a unique law of conservation was in effect: for the majority of scientists, the area on a graph whose axes are the breadth of knowledge and the depth of knowledge is almost identical. It is only possible to increase this total area by working seriously in different areas of science. During his

entire life Lev Al'bertovich followed this rule, becoming vitally absorbed in various problems, especially those in which, as he expressed it, there remained a great deal of "dirt." He not only aimed at "cleanliness", but as a rule, he reduced his results to the most convenient form to understand, and completed the work with the writing of a monograph.

L. A. Vaĭnsteĭn began his series of researches in electronics in the 1950s, and in 1956–57 he constructed the nonlinear theory of traveling-wave tubes. This work is the first rigorous study in this field. These calculations are based on the theory of the excitation of waveguides and resonators that he developed. A number of other results of L. A. Vaĭnsteĭn on the calculation of powerful continuous magnetron type generators, which were proposed and developed by Academician P. L. Kapitsa, are reflected in a series of collected articles "Elektronika bol'shikh moshchnostei" (High-power electronics), which was issued by the Physics Laboratory of the Institute of Physics Problems in 1962–1969. Lev Al'bertovich was not only the permanent editor, but also one of the chief authors of these collections. Together with V. A. Solntsev he wrote "Lektsii po sverkhvysokochastotnoi elektronike" (Lectures on ultra-high frequency electronics, 1973). This book is not only an excellent textbook, but the problems and appendices in the book contain a number of original results.

Another series of papers by L. A. Vaĭnsteĭn is associated with the theory of the transmission of signals and a number of related issues based on the concept of the analytical signal. These studies are presented in the monographs "Vydelenie signalov na fone sluchainykh pomekh (The Isolation of Signals against a Background of Random Noise, 1960 with V. D. Zubakov) and "Razdelenie chastot v teorii kolebaniĭ i voln" (Separation of Frequencies in the Theory of Oscillations and Waves, 1983, with D. E. Vakman). One should also note papers on the flicker effect, on the numerical solu-

tion of inverse (incorrect) problems, and the theory of microwave diagnostics of ultrahigh frequency plasma. In recent years Lev Al'bertovich was occupied with problems lying at the juncture of classical and quantum theory. He has a number of papers on the statistics of photo-readouts, and on the calculation of spontaneous and induced radiation in free-electron lasers.

In addition to his purely scientific activity, we would like to note especially the pedagogical and scientific-organization activity of L. A. Vaĭnsteĭn. For a number of years he lectured at the Moscow Physico-Technical Institute on the electrodynamic of ultrahigh frequencies, and on this basis he produced the monograph "Elektromagnitnye volny" (Electromagnetic Waves, 1957). Many generations of scientific personnel learned and continue to learn from this book; it became the reference book for specialists in radiophysics. Even when he was seriously ill, Lev Al'bertovich substantially revised and supplemented the monograph, whose second edition appeared in 1988. He had many students, a whole scientific school, but he never refused to give a scientific consultation, even to complete strangers. He was the initiator and director of seminars and schools on diffraction which are regularly held in our country. The scientific merits of L. A. Vaĭnsteĭn were recognized with two orders of the Badge of Honor and medals of the USSR.

The interests of Lev Al'bertovich were not limited to science, although it was the goal and meaning of his life from his first student years to his very last days. He was a serious tourist, interested in poetry, and translated poetry professionally. He was a very cultured man with amazing modesty, a principled man of good will. Lev Al'bertovich earned the love and respect of his many friends and students.

The fond memory of Lev Al'bertovich Vaĭnsteĭn, a remarkable man and scientist will forever live in our hearts.

Translated by Christine Gallant